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AN EXPERIMENTAL RESEARCH UPON RABIES.

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Pasteur's work upon and claims in regard to rabies are so well known, more particularly the latter, that any detailed account of them would be superfluous here. Starting with material obtained from a child dead of supposed rabies, in one of the Paris hospitals, he inoculated various animals in different ways—as a result, obtaining a series of symptoms in the inoculated animals of such unvarying character that he classed them under the same head, and considered them to be due to the same cause. Taking the source of his original material into consideration, he felt justified in saying that what symptoms he obtained in his experiments were those of rabies, and that the material with which his inoculations were made contained the specific virus of that disease.

Going on with his work, and extending it in different directions, he announced, first, that by various modifications in treatment to which this "virus" could be subjected its strength could be altered and diminished, and that, by inoculating animals with a virus thus modified an immunity could be established in animals thus treated, against an inoculation with virus of the greatest strength, or against the bite of a rabid animal. Reversing this process, he found that the protective influence was equally established, if the protective inoculations were made *after* the injection of the strong virus, or the bite, had occurred, provided always that the period of incubation of the disease had not passed, and that the symptoms had not made their appearance.

These propositions he proved, or seemed to prove, by a very large number of experiments upon animals, and those most intimate with the results obtained were satisfied that healthy animals—dogs in particular—

could be protected by the measures which he suggested from an attack of rabies after being bitten by a rabid animal.

The next step in this work of Pasteur's, and the one which has attracted so much attention all over the world, was the application to human beings of his methods for the prevention of rabies after a bite by a rabid animal. The preventive inoculations against rabies in human beings began in the summer of 1885, and have been continued ever since, the statistics of results being furnished to the world by means of occasional summaries in the *Comptes Rendus*.

The criticisms to be made against Pasteur in connection with this work are, in the first place, that he fails to give as full details of the individual experiments by which his results have been obtained, as he should have done. By this omission, ground for dissent is given where none might have existed, if scientific men had had the full data before them. In the second place, this omission of detail makes it impossible to know—certainly from any published work of Pasteur's—whether his so-called "virus of rabies," with which his experiments of to-day are conducted, is the continuation of the virus originally obtained from one child, or whether he has taken the opportunity to control the original virus, by obtaining a fresh supply from rabid animals or men coming under observation since the time his investigations first began. In other words, do all of the results which he has obtained depend for their justification upon the reality of a case occurring a number of years ago?

The conditions of the case being as stated, it is hardly to be wondered at that the method of preventive inoculation against rabies has been subjected to severe animadversions, which have at times included its author, and, because the conditions are such as they are, independent observations, and control experiments by, as far as possible, unprejudiced observers are absolutely necessary before the full acceptance of Pasteur's assertions can fairly be demanded of the scientific world at large.

Such independent observations and control experiments may be made to cover a very wide field of investigation, but would include, first of all, the question as to whether others can obtain the same results as does Pasteur—using the same virus, in the same way that he does; secondly, whether this virus which he uses is the true virus of rabies,—a point which will be spoken of more at length further on; and lastly, a more successful attempt than has yet been made to discover the active principle in the material used for inoculation; this active principle seeming, by analogy, to be something with a power of self-reproduction.

So far as concerns the interests of humanity at large, the first is the most important point to be considered, and the endeavor must be made to find out whether—independently of Pasteur's laboratory—there is a virus which, when inoculated in animals, produces the results claimed; whether that virus can be modified in its strength by the treatment he proposes; and lastly, whether, by using this modified virus in a certain

way, an attack of rabies can be prevented. As a corollary to these, the question must be answered as far as possible whether any other material treated in the same way will produce the same symptoms when injected into animals.

It is evidence upon these points in particular, which it is desired to present in the following pages.

Upon the 2d of last July (1886), I received from Dr. Hamilton Osgood two rabbits, one of which had been inoculated upon the 19th or 20th of June, in Pasteur's laboratory, and had died on the 28th of June, and been kept upon ice since that time; the second of which was inoculated on the 21st of June in Pasteur's laboratory by Pasteur himself, and in Dr. Osgood's presence, and, alive when received, died on the night of July 4th. From these two rabbits the material for the series of experiments given in this paper was obtained, and the authenticity of the virus, as coming from Pasteur, is unquestionable.

The method of inoculation is well known, but a brief recapitulation will do no harm. The cord of a rabbit or other animal dead of rabies is removed as quickly as possible after death, and with all precautions against contamination. A small portion of this cord, of the medulla, or of the brain, is first beaten up in a little distilled or sterilized water to soften it, and then an emulsion is made of it by beating up this mixture with a small amount of neutral sterilized bouillon. This mixture is allowed to stand, and when the larger portions of the nervous tissue have sunk to the bottom of the vessel, the supernatant cloudy fluid is used as an injecting material. This entire process, against which much criticism has been directed, is merely *a method* by which a convenient form of injecting mass may be obtained. There is nothing in the least mysterious about it—water alone, bouillon alone, or any other equally bland and innocuous fluid may be employed, but in following an experimenter's work his exact methods should be used, and that has been done in this case.

Upon the receipt of the rabbits spoken of, the first question was, do the cords of these animals contain such material that, when inoculated into others, a constant series of symptoms will be produced with such unvarying regularity that the term "specific" can be applied to the cause producing them? With a view to determining this question, inoculations were begun at that time, and have been continued ever since, with the results given below. The inoculations given in this table were all made by trephining the skull, and the injection, immediately under the dura mater—not into the brain substance—of a very small amount of the fluid prepared as described above. At the head of the table stands the abbreviated record of the two rabbits inoculated in Pasteur's laboratory—including the date of inoculation and of death. Following this comes a tabulated statement of the rabbits which have been inocu-

lated in the regular way by trephining for the purpose of carrying on the virus and of observing the manner of symptoms resulting from such inoculations. The first column gives the number of the rabbits in this table; the second column (in Roman numerals) shows the number, as it stands in the original notes, of the animal from which the virus was taken; the third, fourth, and fifth columns explain themselves.

TABLE I.

First rabbit inoculated in Paris, June 19 or 20, 1886. Dead June 28th. Received July 2d.

Second rabbit inoculated in Paris, June 21st. Received July 2d. Died July 4th.

All of the inoculations given below were done by trephining.

No.	Inoculated from	Date of inoculation.	Appearance of symptoms.	Date of death.
1	I.	July 2, 1886.	July 14, 1886.	July 20, 1886.
2	I.	" 2, "	" 14, "	" 19, "
3	II.	" 5, "	" 28, "	August 2, "
4	II.	" 5, "	" 14, "	July 20, "
5	VI.	" 20, "	" 29, "	August 2, "
6	VI.	" 20, "	" 29, "	" 6, "
7	V.	August 25, "	Sept. 2, "	September 7, "
8	V.	" 25, "	" 2, "	" 12, "
9	XI.	Sept. 7, "	" 13, " (bites.)	" 20, "
			" 14, " (paralysis.)	
10	XI.	" 7, "	" 13, " (bites.)	October 2, "
			" 28, " (paralysis.)	
11	XIII.	" 22, "	" 29, "	" 3, "
12	XIII.	" 24, "	October 4, "	" 7, "
13	XVI.	October 4, "	" 11, "	" 16, "
14	Guinea-pig, II.	" 11, "	" 17, "	" 24, "
15	Guinea-pig, II.	" 11, "	" 14, "	" 22, "
16	XXI.	" 18, "	" 27, "	November 1, "
17	XXI.	" 18, "	" 25, "	October 30, "
18	XXI.	" 18, "	" 24, "	" 30, "
19	XXI.	" 18, "	" 27, "	November 1, "
20	XXIV.	" 22, "	" 30, " (very sluggish.)	" 8, "
			November 1, " (paralysis.)	
21	XXIII.	" 29, "	" 5, "	" 10, "
22	XXX.	Nov. 3, "	" 19, "	" 21, "
23	XXIX.	" 5, "	" 13, "	" 17, "
24	XLII.	" 17, "	" 24, "	December 1, "
25	Dog, V.	" 26, "	Decemb'r 3, "	" 10, "
26	Dog, V.	" 26, "	" 3, "	" 9, "
27	LXXIII.	Dec. 10, "	" 17, "	" 27, "
28	LXXIII.	" 10, "	" 17, "	" 24, "
29	LXXV.	" 24, "	" 30, "	January 3, 1887.
30	LXXVI.	" 24, "	" 31, "	" 6, "
31	LXXVIII.	January 8, 1887.	January 17, 1887.	" 22, "
32	LXXVIII.	" 8, "	" 16, "	" 22, "

TABLE II.

Statistics from the trephined rabbits in Table I.

No.	Time from the inoculation to the appearance of symptoms.	Time from the appearance of symptoms to death.	Time from the inoculation to death.
1	12 days.	6 days.	18 days.
2	12 "	5 "	17 "
3	23 "	5 "	28 "
4	9 "	6 "	15 "
5	9 "	4 "	13 "
6	9 "	8 "	17 "
7	8 "	5 "	13 "
8	8 "	10 "	18 "
9	6 "	7 "	13 "
10	6 "	19 "	25 "
11	7 "	4 "	11 "
12	10 "	3 "	13 "
13	7 "	5 "	12 "
14	6 "	7 "	13 "
15	3 "	8 "	11 "
16	9 "	5 "	14 "
17	7 "	5 "	12 "
18	6 "	6 "	12 "
19	9 "	5 "	14 "
20	8 "	9 "	17 "
21	7 "	5 "	12 "
22	16 "	2 "	18 "
23	8 "	4 "	12 "
24	7 "	7 "	14 "
25	7 "	7 "	14 "
26	11 "	6 "	17 "
27	7 "	10 "	17 "
28	7 "	7 "	14 "
29	6 "	4 "	10 "
30	7 "	7 "	14 "
31	9 "	5 "	14 "
32	8 "	6 "	14 "

TABLE III.

Averages, etc., from Table II.

Shortest period of incubation after trephining	3 days.
Longest " " " "	23 "
Average " " " "	8.6 "
Shortest period from the appearance of symptoms to death	2 "
Longest " " " " "	19 "
Average " " " " "	6.4 "
Shortest period from inoculation to death	10 "
Longest " " "	28 "
Average " " "	14.9 "

From these tables it may be seen, *first*, that, by inoculating animals —rabbits—in the way prescribed—*i. e.*, by trephining and injecting a small portion of an emulsion of a "rabid" cord under the meninges, certain symptoms occur after a period of incubation of varying duration, and that these symptoms are invariably followed by death. *Secondly*, that while the variation in length, of the period of incubation,

and of the time from the appearance of the symptoms until death, varies considerably between individual cases, nevertheless the *average duration* of each of these periods corresponds very closely indeed with the figures given by Pasteur, and quite as closely as a so comparatively small number of experiments could be expected to do.

This correspondence of results is very interesting and important—furnishing, as it does, the first firm ground of belief which would induce a sceptic to go on with further investigations.

The *symptoms* found in all of these animals have been practically identical, so that a description of one case furnishes a picture of what occurred in all. After the operation of trephining and inoculation was completed, the animal would remain stupid from the effects of ether for from fifteen minutes to half an hour, but sometimes not even so long. The most successful operations are performed with practically no loss of blood. After the effects of the ether have passed, the rabbit is apparently as well and bright as ever, and certainly, if one may judge by its appetite, it suffers no shock or any other disturbance from the operation.

Seen at the time and for some days afterward, there is not the slightest sign of any event having occurred out of its ordinary experience. The first thing abnormal which usually makes its appearance, or which is noticed, is a slight weakness of the hind legs—a slight unsteadiness as the animal jumps from one side of the cage to the other. This unsteadiness very often disappears entirely, if the animal be forced to make three or four jumps; it is as if a little stiffness or lameness were removed by exercise. This weakness sometimes makes its appearance suddenly, being very marked in animals which fifteen minutes before were seen to be perfectly strong, so far as close scrutiny could detect.

Before this beginning paralysis can be detected, there is, occasionally, a decided change in the character of the animal; from being lively and affectionate it becomes dull and sluggish, and even fierce—if such a term may be applied to a rabbit; in the latter case it will jump at and bite objects held toward it, and may even growl and spit at them, showing every evidence of a desire to do harm. Such a condition as this is not common, however, and the first symptom which makes a decided impression upon the observer is, usually, that of the unsteadiness of the hind legs already spoken of. This paralysis of the hind legs is progressive in intensity and in character. It passes from the posterior extremities to the anterior, and increases until, at last, the animal lies upon its side entirely unable to move. It is, distinctly, a loss of motor power; reflex action remains until life is actually extinct. The power of deglutition is lost in twenty-four or more hours from the first appearance of any symptoms—and it was at one time supposed that death was caused by starvation. This can hardly be the case, however, inasmuch as the stomach is always full of partially digested food, and the tissues are not

sufficiently wasted to warrant the supposition. Opisthotonos is early marked, and continues in an extreme degree after life is extinct. Before the paralysis has progressed so far that no motion is possible—there is at times a very considerable degree of restlessness—the animal struggles laboriously from one side of the cage to the other, without apparent object, falling over at almost every step. Just before death, there seems to be a revival of the powers—as manifested by a renewal of these struggles; —these movements disappear, absolute quiet ensues, and death occurs so easily that it is oftentimes impossible to tell whether life is or is not extinct. Whilst the symptoms last, the pulse, respiration, and temperature vary in an extreme degree, from very low to very high, and *vice versâ;* the variations being entirely without rhythm or symmetry, and apparently coinciding somewhat with the amount of muscular effort the animal may be making at the time. There is never any diarrhœa, no increase in salivary secretion, and no constant or peculiar change in the appearance of the mucus membrane of the mouth or fauces.

These are the appearances which have been presented in every animal recorded in this paper; not only in those which have been inoculated by trephining, but also in those which have succumbed to subcutaneous injection.

The appearances seen upon post-mortem examination are as uniform as are the symptoms which precede death; and, again, a description of one animal is practically a description of all. Naturally, the point of inoculation and the nervous tissues are the objects of greatest interest. If the inoculation has been by subcutaneous injection, the puncture through the skin may sometimes be made out by the presence of a minute spot of pigmentation, but there is never any sign of a local disturbance. If trephining has been performed, there is sometimes to be seen a very slight elevation of the brain substance under the point in the skull from which the button of bone has been removed. This is as often absent as present, but might be expected to occur by reason of the lack of the usual pressure at the point where the bone has been disturbed. There is never to be seen any sign of suppuration at the point of inoculation, or, for that matter, anywhere else; nor is there any other indication of a local disturbance. In *all cases,* however, whether the inoculation has been by trephining or by subcutaneous injection, the removal of the calvarium shows a congested condition of the membranes of the brain, without, however, any adhesive inflammation of the meninges. The cerebral sinuses are full of dark, clotted blood, but beyond this there is nothing to be seen in the brain. The brain substance is normal in color and consistency, and there are no spots indicating hemorrhage or emboli. The same conditions hold upon laying bare the spinal cord. The vessels of its membranes are sufficiently congested to give it a pinkish look, which disappears almost entirely when these membranes are removed,

and the cord itself presents to the eye almost precisely the glistening white appearance of that of an animal which has been killed by chloroform or ether. In this case, as in the brain, the color and consistency are normal. (It has seemed to me as if there was more congestion in the venous sinuses of the cord membranes in the sacral, lower dorsal, and cervical regions; whether this is accounted for by the anatomical structures of the parts, I am not sufficiently skilled in comparative anatomy to decide.)

The internal organs of the thorax and abdomen present nothing unusual. The heart is always full of dark blood, and has ceased beating in diastole. The lungs are healthy in appearance, of a bright red color, and sometimes show localized spots of a dark red, which are situated on the side upon which the animal was lying when it died. The stomach is usually full of half-digested food, and occasionally shows spots of post-mortem digestion, along the greater curvature for the most part. There is not any marked congestion of its mucous membrane. The small intestine is empty; the rectum full of well-formed normal feces; the bladder is sometimes enormously distended with a clear, amber-colored urine of a low specific gravity and alkaline reaction; at other times it contains a moderate amount of fluid, with a very heavy deposit. A sample analysis by Drs. Wood and Harrington, of the Harvard Medical School, is as follows: Sp. gr. 1.036; reaction very acid; sediment excessive; albumen 0; sediment: amorphous urates, acid urate of sodium, spermatozoa, and mucous casts, some of which were evidently from the kidneys.

The kidneys are normal in appearance; the liver and spleen are sometimes full of blood, and, rarely, somewhat anæmic; the vessels of the mesentery and of the skin are always full of blood, so that the smallest branches may be easily traced.

In none of the animals upon which post-mortem examinations have been made has there been noticed the extreme degree of congestion of the internal organs upon which so much stress has been laid. The absence of this appearance is at least in part readily explained. The animals here spoken of were, during the whole time they were under observation, kept isolated and free from any disturbance whatever, so that no excitement other than that incidental to the disease was produced. On the other hand, clinically speaking, the instant an animal is suspected of rabies it is persecuted and chased from one corner to another, until, unless frightened to death, it is put out of existence by clubs and stones. Under such conditions as these, congestion and even hemorrhage of the internal organs are but the natural result. The absence of the classic "period of excitement" in so many of the animals here recorded may very probably be ascribed to the same circumstances of quiet surroundings and freedom from annoyance. This "period of excitement" is all that makes the

difference in the books between the "furious" and the "dumb" forms of rabies. It precedes the appearance of paralysis, if it occurs at all, and is always terminated by the paralysis.

Taking into consideration the condition of things as it must be in the brain and cord, with each individual cell struggling against some foreign element, it is not difficult to understand how easily these disturbed cells may send various messages to the muscles, and how easily these messages may result in manifestations of excitement. From such a point of view, it is hardly rational to consider the "furious stage" as anything more than a chance appearance in the course of rabies, the likelihood of its presence being diminished as those things tending to excitement are taken away.

In order not to give any ground for the criticism that the results in this paper are too favorable, and in order not to claim too great perfection for the operator's skill, every animal used in this investigation will be spoken of, and where a variation from the results expected has occurred, the explanation, if there is any, will be given in accordance with the facts observed.

The first series of experiments which comes under this head is that which includes those rabbits which were meant to show the usual symptoms—were inoculated for that purpose—and yet failed to do so. These experiments will be found in the following table:

TABLE IV.

No.	Date and method of inoculation.	Result and explanation.
1	Inoculated by trephining, Sept. 22, 1886.	Dead, September 23. Blood-clot on brain. Injury to longitudinal sinus.
2	Inoculated by trephining, Sept. 24, 1886.	No symptoms. Killed Dec. 21, 1886. Dura mater not pierced by syringe needle, and virus washed out.
3	Inoculated by trephining, Oct. 4, 1886.	Savage Oct. 13 to 23, then no signs. Killed on December 21, 1886. Virus partially destroyed (attenuated) by heating.
4	Inoculated by trephining, Oct. 22, 1886.	Sluggish Oct. 30; savage Nov. 5; no signs on 7th. Killed Dec. 22. Virus partially destroyed by heating (attenuated).
5	Inoculated by trephining, Oct. 29, 1886.	Slight paresis Nov. 6; none on 7th; savage 10th to 14th. Killed Dec. 22, 1886. Virus attenuated by heating.
6	Inoculated by trephining, Nov. 3, 1886.	No signs. Killed December 23, 1886. Virus destroyed by heating.
7	Inoculated by trephining, Nov. 5, 1886.	Sluggish on 14th and 15th, then well. Killed December 23, 1886. Virus attenuated by heating.
8	Inoculated by trephining, Nov. 17, 1886.	No signs thus far, January 25, 1887. In this case syringe leaked, and it is doubtful if any of the material was introduced.

Thus it appears that there are eight animals which may be counted as failures; that is to say, the results were not as they were intended to be. Of three, the note appended to Nos. 1, 2, and 8, explains itself; of the others, Nos. 3 to 7, it is stated that the virus was more or less affected by heating in all of them, and this needs a little explanation. The way in which this mistake—for it was one in these cases—occurred, was as follows: It was not always possible to use the animals for inoculation immediately after death, and where this was the case, the bodies were at once frozen to prevent any change. In preparing some of these animals for use they were placed, by a mistaken idea of an assistant, in the *steam sterilizer* in order to hasten the thawing process. The heating was carried too far, and, as a result, the strength of the virus was diminished or destroyed entirely. This table, therefore, does not in the least weaken the force of the first one, but rather seems to show what may happen even when the operator himself takes all the precautions required. The cases where the heating of the animals occurred are also of value, as showing how readily a rise of temperature affects the virus in the cords.

This point will be found illustrated further on by experiments purposely made to test it.

Passing from obtaining such systematic results as are detailed in Table I., the questions arise, How does a variation of the inoculating material influence the result? Does a change in the fluid used produce a change in the symptoms, or are these symptoms simply the result of the introduction of any foreign substance under the meninges of the brain? This point, put in the form of the broad assertion, that nothing but this virus will produce these symptoms, would have to be supported by a very large series of experiments, and this has not been attempted. That variations, or rather a non-appearance of the symptoms, may be the result of changes in the material introduced, is well shown in the accompanying summary.

TABLE V.

Control experiments upon rabbits.

No.	Date of inoculation.	Method and material used.	Result.	
1	Aug. 2, 1886.	By trephining. Virus heated 5 m. to 110° F.	No symptoms.	Well, January 28, 1887.
2	Aug. 2, 1886.	The same.	No symptoms.	Well, January 28, 1887.
3	Sept. 24, 1886.	By trephining. Bouillon and water without any cord.	No symptoms.	Well, January 28, 1887.
4	Sept. 24, 1886.	The same.	No symptoms.	Well, January 28, 1887.

No.	Date of inoculation.	Method and material used.	Result.
5	Oct. 11, 1886.	By trephining. Emulsion of cord dried at 20° C. for ten days.	Very slight paresis, October 20th and 21st. Well, January 28, 1887.
6	Oct. 11, 1886.	The same.	Very slight paresis, October 21st. Well, January 28, 1887.
7	Oct. 19, 1886.	By trephining. Emulsion of cord of healthy rabbit.	No symptoms. Well, January 28, 1887.
8	Oct. 19, 1886.	The same.	Died *suddenly*, Nov. 19, 1886. Liver stuffed full of coccidium oviforme nodules.
9	Oct. 19, 1886.	The same.	Died *suddenly*, Nov. 7, 1886. Liver stuffed full of coccidium oviforme nodules.
10	Oct. 19, 1886.	The same.	No symptoms. Well, January 28, 1887.

The results here tabulated show that in every instance—other conditions being exactly the same—of inoculation by trephining with material different from the usual emulsion of the cord of an animal dead with the paralytic symptoms, nothing occurred which could by any possibility be ascribed to the inoculations except twice. The two cases where slight paresis was observed (5 and 6) only indicate that the strength of the virus was diminished by the drying of the cord used. The two cases in which death occurred (8 and 9) showed absolutely none of the regular signs; there was no change in disposition, no paralysis, no period of incubation, and the post-mortem examination showed the presence of enormous numbers of what looked like miliary tubercles with a few small abscesses. These changes were confined to the liver in both cases. Upon microscopic examination these nodules were found to be *not* produced by tuberculosis, but by the "coccidium oviforme"—a parasite not uncommon in rabbits. (Leuckart, *Parasites of Man*, 1886, p. 203, *et. seq.*)

These results, together with all the others mentioned in this paper, teach us that suppuration is not only not a necessary accompaniment of inoculations after Pasteur's method, but that the moment suppuration appears the experiment is vitiated, so far as proving or disproving anything of Pasteur's assertions is concerned. This is of special importance in connection with Spitzka's paper published in *The Journal of Comparative Medicine and Surgery* for July, 1886, under the title of "How Can We Prevent False Hydrophobia." This author distinctly states that he does not wish to touch upon the question of the existence of such a disease as true rabies, but, at the same time, his authority is quoted, as well as his experiments, to prove that there is no such thing, and, *especially*, that any putrescible substance will produce regularly, after a period of incubation, the paralytic symptoms claimed to arise

from a specific virus. Surely there is nothing in six experiments, incompletely reported, to warrant such an assertion. In the account of the autopsies, only two are given; *purulent meningitis* was found in one case, and *inflammatory red softening* of great extent in the other, together with, in this latter case, a blood-clot, and congestion and tumefaction of the hemisphere on the side upon which the operation was performed! Of course, if any results whatever are to be quoted as arguments in such a case as this, and if symptoms due to any sort of injury to the brain with results differing entirely from those of Pasteur are to be considered as disproving the occurrence of uniform results and pathological appearances, discussion is useless.

Still more striking than any of the results already detailed, were a series of experiments made upon guinea-pigs. These experiments were additional control work, to determine the *specific* nature of the virus employed, and the results obtained, in view of work done at other times, are exceedingly emphatic. An emulsion of the cord and medulla of a rabbit dead with the usual symptoms was prepared in the usual way, and three minims of the solution were injected subcutaneously in the right groin of the full-grown, healthy guinea-pigs. The usual precautions against contamination were taken, and the results are given in the following table.

TABLE VI.

Subcutaneous inoculation of guinea-pigs.

No.	Date of inoculation.	Date of appearance of symptoms.	Result.
1	Sept. 22, 1886.	Sluggish, and slight paresis, October 11th to 16th. Well on 17th.	No symptoms from October 17th. Killed December 27th. No changes.
2	Sept. 22, 1886.	Paresis October 9th.	Dead Oct. 10th. Usual congestion of membranes of cord.
3	Sept. 22, 1886.	No symptoms.	Killed Dec. 27th. No changes.
4	Sept. 22, 1886.	Paresis October 13th.	Dead Oct. 16th. Usual congestion of membranes of brain and cord.
5	Sept. 22, 1886.	No symptoms.	Killed Dec. 27th. No changes.
6	Sept. 22, 1886.	No symptoms.	Killed Dec. 27th. No changes.
7	Sept. 22, 1886.	No symptoms.	Killed Dec. 29th. No changes.
8	Sept. 22, 1886.	No symptoms.	Killed Dec. 29th. No changes.
9	Sept. 22, 1886.	Paresis October 9th.	Dead Oct. 3d. Usual congestion of membranes of brain and cord.
10	Sept. 22, 1886.	No symptoms.	Killed Dec. 29th. No changes.

Here it may be seen, that in four out of the ten animals inoculated symptoms made their appearance which could be referred only to a disturbance of the nervous centres, and in three of these four animals the appearance of the symptoms was followed by an increase in their severity

and extent with a fatal termination. This result is especially striking in view of the fact that in other experiments a very large number of inoculations have been made with all kinds of pathogenic and non-pathogenic bacteria, in the same way, and in the same species of animal, and yet the writer has never seen any result like that here recorded. Lesions extending from a miliary abscess at the point of inoculation to a general septicæmic or tuberculous process have been obtained, but never under any circumstances anything which seemed in the least like a disturbance of the nervous centres. To a practical bacteriologist, therefore, the results given in the preceding table are especially convincing. In no case was there the slightest indication of a local disturbance at the point of inoculation; the skin was as if it had never been touched, so much so, that recourse to the record was necessary to determine where the inoculation had been made.

As a further proof that the symptoms observed in the dead guinea-pigs were in reality due to the same cause as was producing similar conditions in rabbits all the time, the cord of one of the animals was removed, beaten up with distilled water and bouillon in the usual way, and inoculated by trephining into two rabbits. The result was confirmatory, the two animals showing the usual symptoms; the appearance of weakness of the hind legs increasing to general paralysis followed by death. These results are tabulated below.

TABLE VII.

Test of cord of guinea-pig upon rabbits.

No.	Date and method of inoculation.	Appearance of symptoms.	Result.
1	By trephining. Oct. 11, 1886.	Symptoms of paresis Dec. 12th.	Death Oct. 24th, with the usual appearances in membranes of brain and cord.
2	By trephining. Oct. 11, 1886.	Sluggish on 14th, paresis on 15th.	Death Oct. 22d, with the usual appearances in membranes of brain and cord.

Of course, no such investigation as the present would be complete unless observations were also made upon dogs. These animals were used, but not to anything like the same extent as rabbits, for the reason that the behavior of the "specific virus" in rabbits is the point upon which the greatest stress is laid and upon which so much depends. In the dogs experimented upon, the conditions were made precisely the same as obtained in the work upon rabbits. The instruments were sterilized with the same regularity, the operations were performed in the same way, and the material used for inoculation was, as in the other cases, an emulsion of the brain and cord of an animal previously inoculated with similar material. Another reason for not making more

numerous experiments upon dogs is the fact that in every case in which the conditions of a successful inoculation have been fulfilled, the result has been the same, the production of identically the same symptoms in dogs as have always appeared in rabbits treated in the same way; these symptoms coming on after a "period of incubation" extending over from eight to twelve days, then increasing in severity, and finally terminating in death.

The result of these experiments upon dogs is given in the accompanying table:

TABLE VIII.

Inoculation experiments upon dogs.

No.	Manner and date of inoculation.	Symptoms appeared.	Result.
1	By trephining. Nov. 9, 1886.	Paresis, Nov. 21st.	Dead, Nov. 25, 1886.
2	By trephining. Dec. 10, 1886.	Paresis, Dec. 20th.	Dead, Dec. 26, 1886.
3	By trephining. Dec. 10, 1886.	Paresis, Dec. 20th.	Dead, Dec. 26, 1886.
4	By trephining. Dec. 15, 1886.	Paresis, Dec. 20th.	Dead, Dec. 27, 1886.
5	By trephining. Dec. 15, 1886.	Dilated pupils, Dec. 24th; paresis, Dec. 26th.	Dead, Dec. 30, 1886.

In order to be sure of the virus, the cord of one of these dogs was tested by inoculating into rabbits, with the production of the usual symptoms; the rabbits were trephined and inoculated in the usual way; the paralysis made its appearance at the usual time, spread in the usual way, and ended fatally, as usual. The results are given in Table IX.

TABLE IX.

Test of cord of dogs upon rabbits.

No.	Date and method of inoculation.	Symptoms appeared.	Result.
1	Trephined, Nov. 26th.	Symptoms. Dec. 3d.	Death, Dec. 10th.
2	Trephined, Nov. 26th.	Symptoms. Dec. 3d.	Death, Dec. 9th.

This is but a small number of experiments, taken by themselves; their exact correspondence with those made upon other animals is their essential value. In every case, not only were the symptoms during life the same as those observed in rabbits and guinea-pigs, but the appearance upon post-mortem examination was the same, with the single exception that the stomach was entirely empty, except in two cases, in which a small amount of *hair* was found. (In rabbits the stomachs were always full, although this cannot be said to mean much after all, in the face of the assertion of physiologists that one can never empty a

rabbit's stomach, even by prolonged starvation.) In none of the dogs were there any prolonged periods of excitement or fury seen; such a condition as the "furious" stage was entirely absent. They were all subject to short fits of restlessness, during which they moved quickly and aimlessly from one side of the cage to the other. At these times they would occasionally cry out, and sometimes would appear as if in extreme pain; shortly afterward they would sink into a sort of lethargic state, from which it was extremely difficult to rouse them. To what extent these short periods of restlessness would have been extended if the animals had been at large, and how near they would have approached the classic "fury" of a rabid dog, it is, of course, impossible to say. As a matter of fact, the dogs were kept confined and entirely protected from any but the most necessary disturbance, and any alienist has daily experience of the sedative effect of quiet and seclusion upon his patients. In only one case was there any marked desire to bite, and that was only manifested after the animal had been disturbed, as would naturally be the case at any time with a dog sick of any disease. The membranes of the brain and cord were always congested, but there were no localized symptoms at the point of inoculation, nor any greater disturbance on the side where the inoculation had been made; most important of all, there was not the slightest indication of any suppuration.

Before concluding this part of the paper, which has had for its object the determination of the existence of the specific virus called that of rabies, the same thing is to be done here as in the case of the rabbits—the unexpected results and failures in the inoculation of dogs must be recorded. This is done in Table X.

TABLE X.

Failures of inoculations upon dogs.

No.	Date and method of inoculation.	Symptoms appeared.	Result.
1	Subcutaneous injection, Sept. 7, 1886.	No symptoms.	Killed Dec. 10th. No changes.
2	Subcutaneous injection, Sept. 7, 1886.	No symptoms.	Killed Dec. 10th. No changes.
3	Trephined, Oct. 29, 1886.	Symptoms, Nov. 4, 1886.	Dead Nov. 11th. Compression of brain by blood-clot.
4	Trephined, Dec. 10, 1886.	Symptoms, Dec. 11, 1886.	Dead Dec. 13th. Brain injured by trephine; spot of softening about point of injury.

The first two of these animals were inoculated by subcutaneous injection; after being kept under observation for three months they were killed, as no symptoms had appeared. The last two cases explain themselves: in the first, the longitudinal sinus was pierced, and in the second

the trephine slipped during the operation and entered the brain, the result being the same as would occur in any other such injury.

The work already recorded seems to show pretty definitely, that there is a specific virus contained in the cords of rabbits inoculated with the material and in the way spoken of by Pasteur. This point having been settled, the question arises, Is it true that by certain procedures this virus can be diminished in strength, and can animals be protected from an attack of rabies after inoculation with that disease by the method suggested by Pasteur—in other words, does "protection" protect? The remainder of the work done in this investigation has been completed with the object of illustrating this point.

The principle of "protective inoculation" is drawn from these facts: That the cord of an animal dead of rabies, if promptly removed and kept at an even temperature (20° C.), and in a dry atmosphere, will gradually lose its virulence, so that, at the end of ten or twelve days, this virulence will be entirely gone; and that this loss of virulence is gradual and progressive, *not* sudden. The *theory* is, that by injections on successive days, of emulsions of cords of increasing virulence, an immunity is established against an attack of the real disease, or, what is the same thing, against an inoculation with the strongest virus, and that this "immunity" is established whether the inoculation, or bite, occurs before, or after, the protective measures are taken. As a corollary, it follows, of course, that if the inoculation, or bite, occurs before protection, the protection, to be effective, must be completed before the period of incubation of the disease has passed; that is to say, before any deep impression has been made upon the nervous centres.

For the purpose of protective inoculation, cords are to be removed immediately after death with all possible precautions against contamination. They are then suspended in sterilized jars, stoppered with cotton-wool, and containing some hygroscopic material to promote the absorption of moisture. The jars are kept in a dry chamber, as nearly as possible at a temperature of 20° C., and portions of the cords they contain are used for injection as occasion requires,—the cords being made into an emulsion in the usual way. This is the method; but to have everything ready for a protective inoculation at any given time, some calculation is necessary, and a number of rabbits must have been inoculated, so that they will die on the day that it is necessary to begin drying the cords, so that these cords shall be of the proper intensity of virus on the days they are needed. This, for a single series of protective inoculations, when it is known at what date the protection must begin. If the desire is to be ready to perform these protective inoculations at any time, a little reflection will show that rabbits must be inoculated every day, at least one must die every day, and that the cord must be removed and

the drying begun every day. Of course, such work as this can be carried out only at the expense of much time, labor, and money, and it appears at once how much more easy it is to condemn the method by the facility with which inaccurate results may be obtained, than it is to test its merits thoroughly by exact observation.

In the work detailed below, the first procedure was preparing the rabbits so that the inoculations with the strong virus could be made upon the 10th of November, 1886, and the protective inoculations could be begun upon the following day. What was done may be thus tabulated: Rabbits had been previously inoculated so that it was possible on

TABLE XI.

Nov. 1.	To prepare a cord for use on 11th (10 days).					
" 3.	"	"	"	12th (9 days).		
" 5.	"	"	"	13th (8 days).		
" 7.	"	"	"	14th (7 days).		
" 9.	"	"	"	15th (6 days).		
" 10.	Rabbits were inoculated with virus of full strength and protection begun.					
" 11.	With cord of 1st	(10 days drying)			and cord prepared for use on 16th	
" 12.	"	3d	(9	"	)	[5 days.
" 13.	"	5th	(8	"	) and cord prepared for use on 17th	
" 14.	"	7th	(7	"	)	[4 days.
" 15.	"	9th	(6	"	) and cord prepared for use on 18th	
" 16.	"	11th	(5	"	)	[3 days.
" 17.	"	13th	(4	"	) and cord prepared for use on 19th	
" 18.	"	15th	(3	"	)	[2 days.
" 19.	"	17th	(2	"	) and cord prepared for use on 20th	
						[1 day.
" 20.	"	19th	(1	"	) and protective inoculation was completed upon this day, the 20th.	

The value of this method of procedure was tested upon four series of rabbits in four different ways: *First*, by the subcutaneous injection of virus of the strongest quality, and the following of this on successive days for ten days by the subcutaneous injection of virus of progressively increasing strength, as shown in the preceding table; *second*, by carrying out the protective measures, as above, first, and then injecting the strong virus; *third*, by inoculation with the strong virus first, *by trephining*, and then protecting by subcutaneous injection on ten successive days; *fourth*, by protection first by subcutaneous injection, and then inoculation with the strong virus *by trephining*.

The first test is unquestionably the most important and its results are especially striking, for the reasons that the conditions observed approach nearest to what occurs in real life, and because it is against such subcutaneous inoculation—by bites—that the protective measures are adopted in human beings. The results of the test in regard to the first point are given in the following table:

Table XII.

Protective inoculations in rabbits—1. By subcutaneous injection; inoculation first, and then protection.

No.	Date and method of inoculation.	Protective injections.	Result.
1	Nov. 10, 1886. Subcutaneous injection.	Protected Nov. 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, with cord 10, 9, 8, 7, 6, 5, 4, 3, 2, and 1 day old respectively.	No symptoms. Well Jan. 30, 1887.
2	The same.	The same.	The same.
3	The same.	The same.	The same.
4	The same.	The same.	The same.
5	The same.	The same.	The same.
6	The same.	The same.	The same.
7	The same.	The same.	The same.
8	The same.	The same.	The same.
9	The same.	The same.	The same.
		Symptoms Nov. 24.	Dead Nov. 28.

At the same time that these animals were inoculated, a second series was treated in the same way, and with the same virus, and left unprotected, as seen below.

Table XIII.

Control of virus used in Table XII. Subcutaneous injection of rabbits, without subsequent protection.

No.	Date and method of inoculation.	Symptoms.	Result.
1	Nov. 10, 1886. Subcutaneous injection.	No symptoms.	Well Jan. 30, 1887.
2	The same.	Symptoms Jan. 8, 1887, paresis.	Dead Jan. 12, 1887.
3	The same.	Symptoms Nov. 23, paresis.	Dead Nov. 27, 1886.
4	The same.	Symptoms: Fierce on Nov. 22; paresis on Nov. 27, 1886.	Dead Nov. 30, 1886.
5	The same.	Symptoms: Fierce on Nov. 28 to Dec. 8; paresis Dec. 8.	Dead Dec. 13, 1886.
6	The same.	Symptoms of paresis Nov. 27.	Dead Nov. 30, 1886.
7	The same.	Symptoms of paresis Dec. 3.	Dead Dec. 8, 1886.
8	The same.	No symptoms.	Well Jan. 30, 1887.
9	The same.	Symptoms of paresis Dec. 3.	Dead Dec. 7, 1886.

These two tables present a very strong contrast: upon the first, one death is recorded; and upon the second seven are noted. In the first case, the symptoms appeared on the fourth day after the protective injections were completed, and it is perfectly justifiable to suppose that in this case the period of incubation of the original inoculation was too short to permit the protective measures adopted to take full effect. On the other hand, the seven deaths recorded on Table XIII., out of nine rabbits, inoculated and left unprotected, show that the virus used was possessed of great active properties, and the inference is warrantable that some influence for good was exerted by the measures adopted in the first series, subsequent to the injection of the strong virus. The

symptoms of the rabbits which were affected were the same in all cases, and these and the gross pathological appearances correspond exactly with those already detailed, as seen in the rabbits in Table I.

The results of testing the protective injections in the three other ways spoken of, are given below in Tables XIV., XV., XVI., and XVII.

TABLE XIV.

Protective inoculation in rabbits—2. By subcutaneous injection; protection first, and inoculation with strong virus.

No.	Protected.	Inoculated.	Result.
1	Nov. 11 to 20, with cords 10 to 1 day old.	Subcutaneous injection with strong virus, Nov. 29, 1886.	No symptoms. Well Jan. 30, 1887.
2	The same.	The same.	The same.

TABLE XV.

Protective inoculations in rabbits—3. Inoculation by trephining; inoculation first, and then protection.

No.	Date and method of inoculation.	Protected.	Symptoms.	Result.
1	Nov. 10, 1886. By trephining.	Protected Nov. 11 to 20, with cords 10 to 1 day old.	Paresis appeared Nov. 20.	Dead Nov 25.
2	The same.	The same.	Paresis appeared Nov. 21st.	Dead Nov. 25.
3	The same.	The same.	None.	Well Jan. 30, 1887.
4	The same.	The same.	Sluggish from Nov. 21 to 24, then well.	Well Jan. 30, 1887.

TABLE XVI.

Protective inoculations in rabbits—4. By trephining; protection first, then inoculation with strong virus by trephining.

No.	Protected.	Inoculated.	Result.
1	Nov. 11 to 20 with cord 10 to 1 day old.	Nov. 29 with strong virus, by trephining.	Sluggish Dec. 8; fierce to Jan. 1, 1887; well Jan. 30, 1887.
2	The same.	The same.	Paresis Dec. 7; dead Dec. 11.

TABLE XVII.

Attempted control of strength of virus used in Tables XV. and XVI. Rabbits.

No.	Inoculated.	Result.
1	By trephining. Nov. 29, 1886.	No symptoms. Well January 30, 1887. (Syringe leaked badly during operation, and considerable hemorrhage occurred; probably no virus injected.)
2	The same.	Well January 30, 1887. (Longitudinal sinus opened during operation; enormous hemorrhage, and virus probably washed out.)

A study of these tables shows that no symptoms whatever occurred when the protection preceded the inoculation of the strong virus (Table

XIV.), this inoculation being made by subcutaneous injection nine days after the protective measures were completed. In Tables XV. and XVI., where the inoculation with the strong virus was made by trephining, there is recorded a loss of half the animals, when the protection preceded the inoculation, as well as when it followed it. These results are not as fatal as those of Frisch, of Vienna (*Wien. med. Presse*, Nos. 31 and 32, 1886), and, in any case, the objection that this is an unjustly severe test of the method is a valid one, the inoculations by trephining bringing the virus in immediate contact with its place of election, and not allowing for the longer period of incubation which follows a subcutaneous inoculation (bite), against which method of inoculation the preventive injections are directed.

The last table (XVII.) gives the result of two inoculations by trephining, made to test the strength of the material used in the experiments recorded in Tables XV. and XVI. They were both failures—the result being undoubtedly due to the imperfect operation, which latter was caused by haste, owing to pressure of other work. That the virus was of the full strength is shown by the results in Tables XV. and XVI., and also by the symptoms in the animal from which it was taken, and in other animals inoculated with it to carry on the virus.

The work above recorded is what has been done to prove the three propositions:

(1) Is there a specific virus in the brains and cords of rabbits inoculated with Pasteur's material and after his methods?

(2) Does the treatment by drying, proposed by him, modify the strength of this virus? And, finally,

(3) Does injection with such "modified virus" produce an immunity against an inoculation (or bite) with virus of full strength?

The experiments have been given in detail, and, with the utmost frankness, every animal experimented upon has been spoken of, and absolutely nothing has been concealed. The writer began the investigation as a sceptic—as a disbeliever in the existence of a virus which would produce such peculiar symptoms as were claimed; he had not visited Pasteur, was ignorant of his precise methods, and knew nothing more of his results than he has seen fit to publish.

The results of the work here given must speak for themselves: they certainly seem to justify a change from scepticism, complete and absolute, to a belief in, at least, a portion of Pasteur's assertions. Whether the virus used in these experiments is the virus of true rabies or not is a point which cannot be settled until an opportunity is offered for investigation of the result of inoculations with material from a fresh case of rabies in a dog or other animal—*unless* such evidence has already been obtained in Pasteur's laboratory, and *published*. If the latter is the

case such publication has escaped notice up to the date of finishing this paper.

Whether this is the true virus of rabies or not, it is something specific. It may be the true virus, or it may be the true virus altered in some degree by its long transmission from animal to animal, or it may be something entirely different and apart from the true virus; this is a point of mere scientific interest. The practical result is the same in either case, so far as concerns the application of the method to man. It is absurd to suppose that in a country like France, where rabies is so comparatively frequent, and in a series of cases so large and closely observed as that of Pasteur, a certain percentage, and that a large one, of the patients submitted to him, have not been bitten by rabid animals. This being true, even with the few deaths claimed and heralded as "failures," the percentage of fatal results among his cases is unquestionably much smaller than among those in which his method was not adopted.

Every one knows that now, in severe bites or lacerated wounds, more frequent, stronger, and repeated preventive injections are used than was the case at first. This change does not alter the *principle* of the method, however, and as it was that it was desired to test, the original *daily interval* injections were adopted in this research.

A discussion of the minute changes observed has been avoided. The study of the microscopical appearances of the various organs, especially of the brain and cord, together with the results of bacteriological research, form a part of the work by themselves. It is hoped that it may be possible to find something *specific* in this direction at some future time.

The conclusions which may be drawn from the work here recorded seem to be as follows:

I. There exists in the cords and brains of animals inoculated in Pasteur's laboratory a *specific virus*, capable of the production of similar symptoms through a long series of animals.

II. That these symptoms are produced with absolute certainty when the method of inoculation is by trephining the skull, and injection under the dura mater,—with less certainty when the inoculation is by subcutaneous injection.

III. That the strength of this virus is lessened when the cords containing it are removed from the animals and placed in a dry atmosphere at an even temperature.

IV. That the symptoms produced by the inoculation of this virus only appear after a certain period of incubation, distinctly shorter when the inoculation has been done by trephining, than when done by subcutaneous injection.

V. That injections of the virus, modified in strength by drying, and

in the manner prescribed by Pasteur, exert a very marked protective influence against an inoculation with virus of full strength.

VI. That a very moderate degree of heat destroys the power of the virus entirely, whilst prolonged freezing does not injure it.

As will be seen, all of these conclusions are in complete accord with the declarations of Pasteur; their importance lies in the fact that they were reached at a distance from him, and by work entirely separated from any personal influence or bias.

The liberality of the Medical Faculty of Harvard University gave the necessary pecuniary support to this investigation. The energetic and persistent assistance of Mr. Austin Peters, M.R.C.V.S., permitted the completion of much of the work contained in it. Dr. Osgood's great trouble in obtaining and bringing the rabbits to this country, also deserves the author's most sincere thanks.

NOTE.—This paper was prepared for the press when the later results of von Frisch came under notice. The time to investigate the full paper was too short, and the summary as given in the *Medical Record* of January 22, 1887, was made use of. The conclusions to which he has come are precisely the same as those drawn from the work in this paper, so far as they cover the same ground. His further conclusions are based upon work done with virus obtained from street rabies, and seem to establish the identity between this and the experimental virus of Pasteur. His work has led him to the expression of a suspicion, already expressed by the writer in another place, that the intensive method of preventive treatment recently recommended by Pasteur, may very possibly produce the disease. Whether von Frisch is justified in his conclusions by a sufficient number of experiments upon which to base them, the writer cannot say at present; certainly the conclusions of his previous papers upon this subject were entirely too weighty for the foundation upon which they were built.

BOSTON, January 30, 1887.

A NOTE ON THE MEANS OF TOPOGRAPHICAL DIAGNOSIS OF FOCAL DISEASE AFFECTING THE SO-CALLED MOTOR REGION OF THE CEREBRAL CORTEX.

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THE necessity for exact knowledge of the relations between the external surface of the head and the various encephalic regions has arisen so rapidly within the last few years as to force each practical

surgeon to work out the required facts for himself with the aid of the few papers that have appeared on the subject.

In the absence of any such desired comprehensive monograph giving a complete directory, as it were, of those parts of the brain whose function is so far understood as to admit of the localization of lesions within their boundaries, a personal experience, which has so far fortunately been equal to the exigencies of ten cases submitted to operation, may be of use to those who are similarly called upon to explore the cranial cavity.

This paper, therefore, professes to be nothing more than a summary of the means adopted by the writer as topographical guides to definite portions of the brain, and is not in any sense a review of what has hitherto been written in elucidation of the problem under discussion, although such writings in so far as they have rendered invaluable assistance will be referred to, viz., those by Hefftler, Broca, Féré, Lucas, Championnière, Reid, Hare, etc.

The localization of disease of the encephalon is obviously a two-sided process. First, the diagnosis of the seat of the disease in the nerve tissue, by observation of the symptomatic perversion of function; and, secondly, the determination of the particular part of the skull and soft parts covering the focus of disease.

The second part of the process has usually been separated from the first, and considered by itself, under the title of cerebral topography, and may, doubtless, with advantage be thus studied as a distinct subject; but it really is in closer connection with the other division, namely, cerebral localization, than may appear at first sight to the anatomist. The truth of this will be obvious at once upon consideration of the fact that cerebral topography, pure and simple, consists in a determination of the exact relation of the various sulci to the exterior, yielding, of course, invaluable and indispensable results; but, further, that a minute study of localization of function in the cerebrum shows that although these same sulci possess a fundamental value in the separation of areas possessing different functions, that such topographical division is not to be regarded as absolute and definitive. This fact, of course, in no wise militates against the general principles of cerebral localization, and it is, besides, only more specially true of those functions which are very largely represented in the nerve centres.

As an illustration of the truth of this general proposition, we may point to the mode of representation of the upper limb, as recently defined by Dr. Beevor and myself (following upon the lines laid down by Dr. Ferrier), from which it would appear that several and the same segments of the limb are represented in the cortex on both sides of the fissure of Rolando. Indeed, although fortunately the representation of function—*i. e.*, in this case movement—is exceedingly constant and clearly defined,

yet the delimiting value of the various sulci has still to be determined, it being perfectly clear from the observation of examples, such as that just quoted, that mere physical characteristics, such as length, depth, etc., of a sulcus, heighten its value, not as a *boundary*, but as a *landmark* of function. In this way we shall subsequently find that, while always having to start an attempt to localize disease, by first determining the relative positions of the different sulci, the completion of the inquiry will only be accomplished by application of the knowledge of the concentration of the representation of any given function about certain points in those sulci.

It consequently follows that the localities in which different functions are represented are not separated by hard outlines (and this belief is also borne out by experiment), but that they occupy absolutely constant focal positions, and in this way will in the, let us hope, immediate future be very accurately mapped out. The above considerations also bring us back to the point we started from, viz., the close union of the representation of function and the topographical positions of the sulci, for the mapping out of the localities of function is only to be done by the accurate observation of experiments on the lower animals, and by the very rare opportunities of clinical observation in cases of very closely delimited disease.

The last-named method, viz., clinical observation of the effects of disease, furnishes but barren results, as may be seen, for instance, from the exceedingly slight advance which has been made by its means in our general knowledge of the pathology of new growths. On the other hand, the determination of the representation of cerebral function by means of experiments upon the brains of animals closely allied to man, has proved most fertile in the production of facts upon which very active treatment has been safely based. Indeed, we owe nearly all we know about the function of the different parts of the cortex cerebri to experiments upon the lower animals.

Fortunately, it is easy to establish the exact homologies between the parts possessing certain functions in the brains of the higher monkeys, and the like parts in the brains of men. The identity of the various localities of function is readily determined, and, speaking from the evidence at our present disposal, is fairly complete.

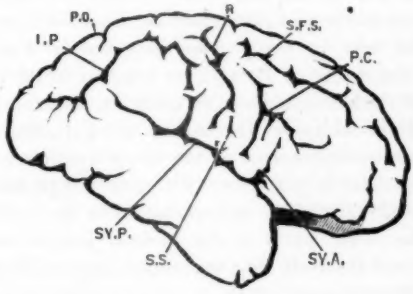
Localization in the Cerebrum of the Function of Movement of Different Parts of the Body.

The localization of the special sense functions in the human cortex cerebri is still a matter of such contention as regards minute detail that it would be unpractical to devote any part of the present paper to its consideration, and especially as from lack of immediate personal experi-

ence, all that could here be said on the point would be little more than a mere digest of monographs and collected works available to all neurologists. Such a digest, it need hardly be added, is altogether outside the original scope of this note. Limiting ourselves, therefore, to the subject of the representation of the function of movement, we will proceed at once to sketch the position of the various localities of such representation, according as they are known at the present day, bearing in mind the outlines and nomenclature of the sulci and gyri of the centre of the brain.

It would also be foreign to the subject of this paper if it included a very full description of the well-known anatomical details of the configuration, etc., of the cortex of the brain; but many important details must be referred to, and, for the sake of completeness of illustration and by way of preface, the reader is referred to the accompanying diagram, Fig. 1, which is traced from a photograph of the right hemisphere of an

FIG. 1.



P. O. Parieto-occipital fissure (external).
I. P. Intraparietal sulcus.
R. Fissure of Rolando.
S. F. S. Superior frontal sulcus.
P. C. Parietal sulcus.
Sy. A. Anterior limb of the Sylvian fissure.
Sy. P. Posterior limb of the Sylvian fissure.
S. S. Subordinate sulcus separating area of absolute adduction of vocal cords.

adult English woman. It may be advisable, moreover, to point out that, as the representation of one and the same function may extend over and beyond this or that sulcus, as has already been mentioned, it is advantageous mentally to subdivide this region into horizontal levels, for the variation in the representation of function will be found to be greatest in passing over the "motor" area from above down. In other words, the nature of the function of the convolution bordering the longitudinal fissure, is more different from the function of the convolution forming the upper edge of the Sylvian fissure, than is the function

of the anterior third of the so-called motor region from the posterior third.

We may say, therefore, with perfect anatomical truth, that this great variation in representation from above down, and the slighter difference from before back, is correlated with the decrease in the size of the so-called motor corpuscles from the paracentral lobule downward, and their comparative constancy in volume in one and the same horizontal level.

It will thus be found convenient to conceive of the convex region, known popularly as the "motor area," as being subdivided nearly horizontally by imaginary extension backward of the superior and inferior frontal sulci, and of these levels again as interrupted by subdivisions, often of a very arbitrary but useful character. For instance, a line drawn forward from the lower end of the intraparietal sulcus and parallel to the fissure of Sylvius, will be found to mark very distinctly the division between the representation of movements of the upper limb and of the face behind the fissure of Rolando. A digression may be made here for the purpose of strengthening what has just been said, by pointing out, as may be easily done from the facts of comparative anatomy, that the fissure of Rolando as a sulcus which is transverse to the long axis of the hemisphere, is an intruder, disturbing the harmony of the longitudinal folding of the cortex into gyri, which is so characteristic of the convoluted cortex of the lower animals, and is probably of primal ontogenetic importance. We shall see presently, moreover, that this wide difference of the representation in the upper, as compared with that of the lower parts of the parietal lobe, is not confined to merely the parts of the body that are moved, but that it also determines the nature of the movement itself.

There remains yet another consideration of great general importance and which by reason of its applicability to every variety and degree of so-called motor function must now be discussed and for practical purposes settled in these prefatory remarks. We refer to the closely debated question of the intimate nature of the representation of movement that is to be obtained from any one given portion of the cerebral cortex.

To illustrate: If the electrodes of an induction coil be applied to the so-called motor cortex of a monkey, just above the lower end of the intraparietal sulcus, there will result the simple movement of flexion with adduction of the thumb—that is, practically speaking, movement in only one or at the most two segments of the limb; whereas, if the current be applied above the hinder end of the superior frontal sulcus, there will occur synchronous movement of all the segments of the lower limb and of one or two of the upper limb, the current in both this and the preceding instance being only of just sufficient strength to evoke movement. In these two cases it is obvious that the "nature" of the move-

ments evoked by exactly the same means is completely different; the difference consisting both in the extent of the body moved as well as in the kind of movement produced. If now this simple effect of what may with justice be termed a minimal stimulation (Beevor and myself) be further complicated by increase in the force of excitation or in the proneness of neighboring centres to become involved in the act of discharge, we find movement is generated thereby in those parts of the body which lie next in serial order to the parts which were moved by the minimal stimulation. The movement produced by minimal stimulation has been termed, by Dr. Beevor and myself, the primary movement represented in that part,[1] and the subsequent additional movements as secondary. The existence of the experimental fact of the primary movement and the close correlation of neighboring parts is unquestionable, but it naturally affords material for divergence of opinion in its interpretation, and seems to the writer to suggest the following view of the manner in which movements are represented in the "motor" cortex.

Thus we are justified in believing that in any given part of the cortex, as minute as can be examined experimentally, there is represented a definite movement or combination of movements of a definite segment or segments of one or both of the opposite limbs; such movements or combination of movements being the primary movement as defined by Dr. Beevor and myself, and being elicited, be it remembered, by minimal stimulation only. Further, that secondary movements are due to the subsequent invasion by the discharge of nerve energy of those portions of the cortex which lie nearest to and are in close relation to the parts stimulated.

Such a view, of course, connotes that of the existence of a close commissural connection of one centre with another, and more than that, of the overlapping of the borders of such centres, or, in other words, the commingling of neighboring representations of movement.

The old opposition against the grand truths of cerebral localization, rested upon the gratuitous assumption that a demonstration of the representation of single movements of single muscles was necessary to the establishment of the accuracy of the theory. And this species of criticism continued to exist even after the crushing demonstration by Dr. Hughlings Jackson, that representation of function in this portion (his "middle level") of the central nervous system meant representation of movements, and not of muscles, and, indeed, it may still exist in the minds of some of those who forget that it is impossible for us to contract purposively one single muscle in the body.

To sum up the foregoing: in seeking for the most profitable utilization of the facts, plentifully derived from experiment and scantily from

[1] For the introduction of these terms Dr. Beevor and myself are responsible, and details of the work upon which they were based will be found in the Proc. of the Roy. Soc., 1886, and Phil. Trans., 1887.

clinical observation, for determining the situation of localities of definite function (motor only, be it remembered), it is clear that we must first picture to ourselves very distinctly the extent of cortex in which definite segments of the body are represented, and then to define similarly the areas in which the various given movements are represented.

This must now be done with the help of diagrams, it being distinctly understood that the lines limiting the areas of representation either of segments or of movements are purely provisional, though founded upon the experiments of Dr. Ferrier, Professor Schäfer and myself, Dr. Beevor and myself, and also on my cases of operation on man. To be strictly accurate, judgment respecting such limitation of "centres" must obviously be restricted until our knowledge of the degree of representation in man is fully ascertained.

I. The Topographical Relations of the so-called Motor Region to the Exterior of the Skull.

In accordance with the object of this paper, it will now be best to describe the surface markings of the portion of the head inclosing the parts of the brain under discussion. There can be little doubt that the risk of topographical error increases in measuring from below upward;—*i. e.*, in mapping out the convexity of the calvaria by lines drawn upward from a line carried along the side of the base of the skull. It behooves us, therefore, to seek for means of measuring the position of the vertex parts of the brain from fixed points in the middle line.

The sutures (*vide* Fig. 2) occupy, of course, the foremost position among the *points d'appui* of topography. They need no description here, neither is any detail required of the other landmarks on the vertex beyond a few passing notes. Next to the sutures in importance come the eminences, and the so-called motor region is limited, roughly speaking, in front by the frontal eminence and posteriorly by the parietal eminence. As regards these eminences, it is easy to determine by taking antero-posterior and supero-inferior views of the skull from a short distance, the centre point of the elevation in each case, and this spot is known for topographical purposes as the eminence itself, though the descriptive anatomist would also include the sloping sides of the elevation. This wider view, of course, is useless for our present purpose, since it in no wise defines the limits of the eminences.

Next to the eminences, of course, will come in value the temporal ridges. These consist, and this can be verified on almost any skull, of two well-marked lines, the lower of which has alone been noticed till recently. This lower one is the more strongly marked, it is continued upward from the external angular process of the frontal bone, limiting anteriorly and superiorly the deep hollow of the front half of the temple

fossa and following a semi-circular course along the lower part of the parietal bone till it is lost just above the attachment of the pinna. The point where it crosses the coronal suture was more conveniently and

Fig. 2.

This figure, from a photograph, shows the head of a cadaver from which the scalp has been removed opposite the so-called motor region of the brain. For this photograph and that of Fig. 3, I am very greatly indebted to my friend Dr. Wilson, Senior Resident Physician to the National Hospital for the Paralyzed and Epileptic, who prepared them from my directions under circumstances of inconvenience and special difficulty.

S. Edge of cut scalp.
P. Pericranium.
C. Coronal suture.
S. T. R. Ridge of temporal fascia, or superior temporal ridge.
I. T. R. Ridge of temporal muscle, or inferior temporal ridge.
S. Q. Squamous-parietal suture.
T. M. Temporal muscle.
T. F. Temporal fascia.

appropriately termed by Broca the stephanion. This temporal ridge marks the upper border of the attachment of the temporal muscle. Above it runs a second ridge or line also commencing anteriorly at the angular process of the frontal bone, but soon leaving the lower temporal ridge, until opposite the middle of the lower border of the parietal bone it is, as a rule, fully one centimetre above that of the temporal muscle. The uppermost ridge marks the attachment of the temporal fascia, and, it may be added, the periosteum covering the bone of the vertex and

lower down beneath the muscle is more firmly attached to the temporal ridges than elsewhere. These two ridges might be advantageously known as the ridge of the temporal muscle and fascia respectively (*vide* Fig. 2). All these points can be made out on the living subject and with greater ease, of course, if the head be shaved. The only difficulties met with are in the determination of the coronal suture and the temporal ridges.

The coronal suture can be readily made out in most cases by steadily pressing the scalp with the thumb backward and forward over its supposed site. With a little practice the dentations can be detected, especially just above the stephanion. The bregma being easily defined by measurement or otherwise, the upper third of the coronal suture, which is usually very difficult to feel, can be filled in by continuing upward the line of the lower part discovered by palpation. We shall see, presently, that the determination of the coronal suture is of extreme importance.

The ridge of the temporal muscle can be most readily determined by telling the patient to shut the mouth very firmly: the temporal muscle will then stand out in relief and the outline of its upper margin becomes very marked. In the majority of instances the ridge of the temporal fascia can be felt by palpation. If not, it can be detected as being the first point at which the sloping bones of the roof of the skull become vertical to form the side walls.

In some instances the coronal suture cannot be detected by palpation, but in its neighborhood there can be felt a rounded ridge which is bounded posteriorly by a distinct though shallow groove occupying the anterior sixth of the parietal bone, while a similar but less marked groove exists on the frontal bone in front of the ridge bearing the suture. The finger thus starting from the parietal eminence would, if carried forward, first gradually pass down into the above-mentioned groove, then would leave that crossing the ridge containing the suture and lose itself in the shallow groove on the frontal bone in front of the suture.

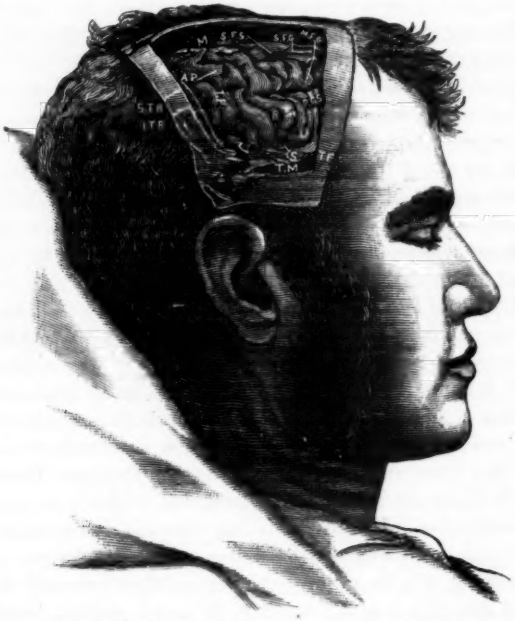
There is one line of suture of which no mention has yet been made, which is at the same time perhaps more important than the other, viz., the parieto-squamal (*cf.* Figs. 2 and 3). This semicircular suture is, of course, buried beneath the muscle in the temporal fossa, and attains its greatest height in a vertical line drawn in front of the articulation of the lower jaw, being at this point at about the junction of the upper and middle thirds of the distance between the ridge of the temporal muscle and the upper border of the zygoma. The H-shaped junction of the parietal, great wing of the sphenoid, the frontal, and squamous bones, marking as it does the divergence of the branches of the Sylvian fissure, was termed the pterion by Broca, and forms the commencement of the squamous suture.

The external relations of the pterion are, of course, also obscured by its being covered by the temporal muscle, but the sloping transverse (*i. e.*, antero-posteriorly directed) bar of the H indicating the sutural union between the anterior inferior angle of the parietal and the upper and posterior border of the great wing of the sphenoid is situated, generally speaking (*i. e.*, for English adults) half way between the stephanion and the upper border of the zygoma, the measurement being taken along a line drawn vertically to the zygoma from the stephanion.

THE RELATION OF THE CONVOLUTIONS OF THE "MOTOR" AREA TO THE PROMINENCES ON THE SKULL JUST DESCRIBED.—The first fissure of these regions to be determined in position is that of Rolando (*vide* Fig. 3). Hitherto this has been sought for by erecting verticals from a horizontal base line drawn through the external auditory meatus; but these lines, even with the aid of the instrument of Lucas-Championnière and others, are liable to error, from which it is believed the method now to be described is comparatively free. The better plan is first to adopt the method devised by Professor Thane, of University College, London, for locating the upper end of the fissure of Rolando. His plan is to take the length of the middle line of the head from the root of the nose—*i. e.*, the glabella—to the occipital protuberance or inion and then by halving the result to obtain the centre of the middle line of the head. The upper end of the fissure of Rolando will be found in adults to be situated half an inch behind this centre-point of the head. The only possible objection to this rule can be that the definite expression is introduced in terms of inches. But from numerous observations by Professor Thane and the writer this slight drawback has been found to have no practical importance whatever. In very many cases the spot indicated by this plan will be found to be exactly the upper end of the fissure. Given the commencement of a fissure at its highest point so correctly, it is obvious that if its direction is at all constant its exact position must be easily discoverable and determined. This is the case. Dr. Hare, of Edinburgh, has shown that the angle which the fissure makes with the middle line is very fairly constant. The extremes determined by him did not vary more than a few degrees and the mean of his measurements was sixty-seven degrees. To facilitate the clinical combination of the foregoing facts, I have caused to be constructed a very simple instrument of soft iron (nickelized) consisting of a long (10 inch) strip one centimetre broad, from the middle of which branches off another strip (about 6 inches long), the two making an angle anteriorly of sixty-seven degrees. On the short arm is marked on both sides a scale of inches commencing half an inch from the middle line. This instrument is used thus: The long arm is laid upon the middle line of the head which has been previously marked; the angle between the arms is then made to coincide with the theoretical situation (Thane) of the upper end of

the fissure of Rolando; a line drawn down the anterior border of the short arm will now give the situation of the fissure perfectly accurately for the upper two-thirds of its course. The fissure of Rolando, however, is not a perfectly straight line. Both in the monkey (as observed by Beevor, myself, and Hare) and in man, the fissure runs downward and

FIG. 3.



View of the same head as Fig. 2. The base being removed by a vertical saw-cut through the stephanion (inferior), by another along the squamo-parietal suture, by one parallel to the fissure of Rolando and just in front of the parietal eminence, and by one along the outer border of the sagittal suture.

M. Margin of the hemisphere.
S. F. S. Superior frontal sulcus.
S. F. G. Superior frontal gyrus.
M. F. G. Middle frontal gyrus.
P. C. S. Precentral or vertical sulcus.
A. F. Ascending frontal gyrus.
A. P. Ascending parietal gyrus.
I. P. Intraparietal sulcus.
R. Fissure of Rolando.
S. Fissure of Sylvius.
T. M. Temporal muscle.
T. F. Temporal fascia.
S. T. R. Superior temporal ridge.
I. T. R. Inferior temporal ridge.
U. Subordinate sulcus in ascending frontal gyrus which unites the phonatory centre.

forward, but when about opposite the lower end of the intraparietal sulcus it becomes directed more vertically as it approaches the Sylvian fissure. It thus forms a slight knee at this part of its course. Both in the higher and lower animals the amount of the flexure of the fissure varies slightly but distinctly in different individuals. For this reason, although the lower end of the fissure does not vary more than a quarter

of an inch in a horizontal plane, no line, more or less vertical, can determine it accurately. Nor is one necessary, as we shall see directly.

The next fissure to be considered is the fissure of Sylvius, consisting as it does of a short anterior and long posterior branch, and forming the inferior and to a slight extent the anterior limit of the "motor" region.

It has already been seen that the Sylvian fissure commences at the pterion, the anterior branch running upward and forward continuing, as it were, the line of the sphenoido-squamous suture but commencing one or two millimetres in front of it. The posterior branch passes upward and backward just above (on the average, one-half of a millimetre) the squamo-parietal suture as far as its highest point, and there leaving it continues by curving slightly upward toward the centre of the parietal eminence, which it nearly reaches.

By reason of the fact that this extremely important fissure gives off no branches save of a very subordinate character, and since it is so easy to localize its position, little more need be said here than to emphasize the fact that the anterior branch just in front of the lower end of the coronal suture limits the so-called motor region anteriorly, while the posterior branch, just below which lies the squamo-parietal suture, bounds the region inferiorly.

The pre-central or vertical sulcus, is the next important cortical landmark to be studied. This sulcus (not a fissure, there being only five fissures in the brain, viz., the longitudinal fissure, the Sylvian, the Rolandic, the parieto-occipital, and the great transverse fissure of Bichat), unlike the fissure of Rolando, runs parallel to and just behind the coronal suture. It is of extreme importance, as we shall see, since it divides two convolutions of very different functions, and because it has on either side of it convolutions in which most extensive representation of movement exists. Following the coronal suture, it then runs upward and slightly backward, so that when a tangent to the bregma is in a horizontal plane it does occupy a very vertical position, hence its second but inferior name of "vertical" (*vide* ascending frontal convolution infra). This pre-central sulcus, as a rule, reaches to about the centre of the fissure of Rolando, and from it diverges forward the inferior frontal sulcus about opposite the superior temporal ridge. The point named by Broca, the stephanion, should also be applied to the point where the superior temporal ridge crosses the coronal suture, and then we may speak of the superior and inferior stephanion. In some skulls these two are practically almost identical, owing to variations in the attachment of the temporal fascia and muscle respectively. Above the point of origin of the inferior frontal sulcus, the pre-central sulcus continues half way across the root of the middle frontal convolution. The localization of the upper part of the pre-central sulcus is, therefore, an easy matter, and further, the convolution passing around its lower end, and separating it

from the Sylvian fissure, is very frequently of the same breadth, viz., about one centimetre, which may *practically* be regarded as constant.

It will be best now to consider the topographical value of the superior frontal sulcus. This usually fairly constant sulcus commences in the ascending frontal convolution about midway between the fissure of Rolando and a line continued upward in the line of the pre-central sulcus. Its commencement, a short upward sloping furrow, is thus well behind the latter sulcus, and is readily determinable on the skull after the positions of the fissure of Rolando and coronal suture have been defined. Both superior and inferior frontal sulci run forward and slightly downward, being for the most part parallel to the longitudinal fissure, and much complicated by the presence of many secondary branches. The rest of the frontal division of the so-called "motor" region, we shall return to in speaking of the convolutions, but it cannot be too clearly understood that this is the most important part of the excitable area of the cortex.

Behind the fissure of Rolando lies the intraparietal sulcus. This sulcus is noteworthy as forming a well-defined posterior limit to the "motor" region. It can be discovered externally by first localizing the position of the fissures of Rolando and Sylvius, and although it gives off no branches beyond very subordinate ones, it passes from the parietal lobe into the occipital, aud thus limits most accurately the posterior border of the "motor region." Its commencement at its lower end has been before referred to as being opposite the knee-like bend in the fissure of Rolando. As it passes upward it very soon tends to leave the fissure of Rolando, and thus forms the ascending parietal convolution, the summit of which is so widened as to receive the name of a lobule, namely, the superior parietal lobule. To this we shall presently return, as its topographical determination externally is extremely important. The intraparietal sulcus turns directly backward, below the horizontal level of the superior frontal sulcus, and it gradually comes to run more or less parallel to the longitudinal fissure, passing round the outer end of the external parieto-occipital fissure (which, probably in man, forms the posterior limit of the vertex border of the "motor" region), and terminates in the occipital lobe. In the first part of its course, while forming the posterior border of the ascending parietal convolution, the sulcus lies (externally) midway between the line of the fissure of Rolando and the centre of the parietal eminence. Further up, as it passes backward, it lies midway[1] between the longitudinal fissure and the centre of the parietal eminence. It is thus easily determined.

The parieto-occipital fissure may be briefly referred to in this connec-

[1] The commonest line (*i. e.*, form) of the intraparietal sulcus has yet to be determined, and the real breadth of the ascending parietal gyrus consequently remains unknown also. The line of the intraparietal sulcus may, in many instances, pass closer to the parietal eminence than is stated above.

tion, but this must be more by way of completeness of description than from absolute knowledge whether it really does form a landmark of representation of movement in the cortex of the human brain. It is a small fissure, rarely more than an inch in length in the adult; it is directed outward and slightly forward, thus nearly at right angles to the longitudinal fissure (into which it opens), and it lies almost invariably just in front of the apex of the lambdoid suture (usually two to three millimetres in front of that point).

The first half of the description of the relations between the "motor" cortex and the skull being thus completed by the study of the sulci, it remains to consider briefly the convolutions formed by them. And since the size and proportions of the convolutions are absolutely dependent on the distribution and state of the sulci, little remains to be added to what has been said above, save in the way of general statements in especial reference to the various centres of representation which are contained in each, and in noting at the same time the presence of those secondary sulci which appear to have a power of restricting[1] the areas of representation.

The first convolution of greatest importance is the ascending frontal. Beginning with its base or foot, which we have just seen to be covered by the anterior inferior angle of the parietal bone, we must first point out that, unfortunately, there prevails some indefiniteness concerning the terminology of this important spot. Thus the gyrus which separates the lower extremity of the fissure of Rolando from the fissure of Sylvius, was named by Broca the operculum, but apart from the fact that Gratiolet had already appropriated this expression to denominate the posterior border of the external parieto-occipital fissure in monkeys, it was obviously highly undesirable thus to name specially a small portion of brain surface which could not be accurately delimited. Moreover, the introduction of the term was superfluous, since owing to the fortunately very distinctly vertical direction of all the principal sulci about this spot, there is no difficulty whatever in marking off the foot of the ascending frontal convolution by simply mentally prolonging the fissure of Rolando posteriorly and the pre-central sulcus anteriorly into the fissure of Sylvius.

And, of course, at the same time we are as distinctly defining the foot of the ascending parietal on the one hand and the hinder end of the inferior frontal convolution on the other.

To return now to the ascending frontal, we note that in man the foot of this convolution is sometimes narrow, unlike the homologous structure

[1] In speaking thus of a sulcus restricting representation of (motor) function it must be here stated that excitation by faradism of the walls or bottom of a sulcus evokes no movement, and further that, as is well known, the large "motor" corpuscles of the fourth layer are not found in the walls deeper than the depth of the cortex, measuring perpendicularly to the surface of the hemisphere.

in monkeys, a very suggestive difference. Although it may be narrow, this foot constantly presents a partial division by a vertical subordinate sulcus (s. s. Fig. 1), and this is always present in the monkey, in which animal it has a very decided significance (*vide* page 357). Opposite the hinder end of the middle frontal convolution the gyrus attains its greatest breadth, and narrows again very markedly opposite the hinder end of the superior frontal sulcus, this narrowing also conditioning, or rather coinciding with a difference in representation of function. Above, the gyrus terminates in the marginal convolution.

Unlike the two great central gyri, the frontal convolutions present numerous subordinate sulci. They decrease in vertical breadth from below upward. The inferior frontal gyrus is broader posteriorly where the movement of the head and eyes is represented, and without entering into a discussion as to what is causative of the greater breadth of the base of the frontal lobe as compared with its anterior extremity, we may note that the vertical width of the hinder end of the inferior frontal convolution is correlated with the upward direction of the anterior limb of the fissure of Sylvius, which may figuratively be regarded as pushing the gyrus upward. (*Vide* Figs. 1 and 2.)

The middle frontal convolution preserves its breadth fairly constantly, but we have nothing to do in the present paper with the consideration of the architectural arrangement of the forepart of the frontal lobe, since that, so far as we know, is not "motor," if efferent in function.

The hinder end of the superior frontal convolution is limited posteriorly by an imaginary line drawn from the hinder end of the superior frontal sulcus to the longitudinal fissure, and parallel to the fissure of Rolando. The external relations of these parts have been already dwelt upon, and it only remains, therefore, to state that this gyrus also, like the next, though narrower, is of fairly constant breadth, lying parallel to the longitudinal fissure.

It will be remembered that the superior longitudinal sinus lies just to the right of the middle line, so that its left border is almost coincident with the exact medial line of the head. It thus necessarily follows that the inner border of the right hemisphere will lie, as a rule, just outside of the line joining the ends of the widest denticulations of the sagittal suture: while, on the other hand, the margin of the left hemisphere will border closely on the middle line.

The ascending parietal convolution is neatly marked out by the intraparietal sulcus behind, and the fissure of Rolando in front. Soon after it has passed the genu of the latter fissure it widens to form the superior parietal lobule, as before mentioned, and by reason of its continuing posteriorly with the occipital lobe around the outer end of the parietal occipital fissure, it is not surprising to find that the part termed this lobule is divided by subordinate sulci. In the monkey there is a small

and subordinate, but remarkably constant sulcus, on a level with the superior frontal, which marks off a small portion of the gyrus anteriorly. This sulcus is always present in man, and according to the degree that it is developed the parietal lobule varies in shape. The exact arrangement of the sulci here requires further attention.

It is, of course, at present impossible to divide the lower margin of the parietal lobule from the rest of the convolution, but it is to be hoped that localization will clear up this problem in man ere long.

Mesial Surface.—The only part of the mesial surface which concerns us at this present time is the marginal convolution, or, more strictly speaking, its posterior half, the paracentral lobule being included in the same. The external topographical anatomy of this gyrus is, of course, simply that of the border of the hemisphere mentioned above.

II. The Enumeration and Limitation of the Areas of Representation of the Different Parts of the Body in the Gyri thus Topographically Determined.

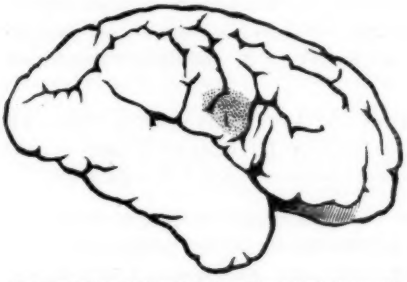
We are now in a position to set before ourselves the quality and extent of the representation of the various parts of the body in this so-called motor region, and so, knowing where each primary (see page 347) movement is represented, we shall be able, with the aid of the topographical facts just detailed, to picture to ourselves the seat of a lesion which has revealed itself by evoking or paralyzing that particular movement.

In discussing the manner in which we propose to regard the functional arrangement of the convolutions, reason was shown (page 345) for figuring to the mind a horizontal division of this region of the brain; and in treating of the exact localization of function in these parts we shall adopt these views as of great assistance.

We may well begin the consideration of the extent and nature of the movements represented in this region with those of the face and throat. If a line (referred to before) be drawn through the lower end of the intraparietal sulcus and through the genu of the fissure of Rolando, thus cutting off the bases of the ascending convolutions, it will indicate with perfect accuracy the region in which the facial movements blend with those of the upper limb. The representation of the movements of the face and throat extends from the line just mentioned superiorly to the Sylvian fissure inferiorly, and from the pre-central sulcus with its theoretical inferior continuation anteriorly, and the theoretical extension of the intraparietal sulcus to the Sylvian fissure posteriorly. The exact details of the representation of the movements of the face and throat have not yet been thoroughly investigated experimentally, nor (as might have been anticipated) has clinical observation filled up the blank.

Several points have, however, been made fairly clear by the work of Dr. Ferrier, Professor Schäfer, and myself, and Dr. Semon and myself. Further, in one case of exploratory operation (Case V.) in this region the writer applied the faradic current (one litre bichromate cell, Du Bois Reymond induction coil, and platinum electrodes) to the surface of the cortex with the view of determining the limitation of the representation of the region of the face, the object of the operation being to excise this area. The electrodes were applied at a spot in the foot of the ascending frontal

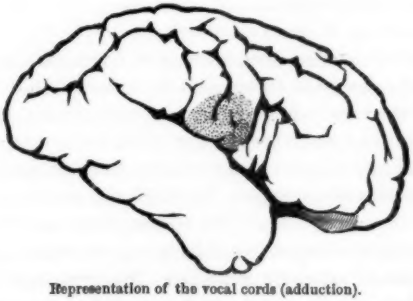
FIG. 4.



Representation of the upper face and angle of the mouth.

convolution, at that point which is the junction of the middle and upper thirds of the facial area, the effect of the stimulation being the production of movement of the jaw toward the left, and of the left angle of the mouth.[1] It is in the upper part (*vide* Fig. 4) of the facial area that the

FIG. 5.



Representation of the vocal cords (adduction).

movements of the opposite angle of the mouth, etc., viz., all the groups of muscles being involved which make up what is clinically known as

[1] This spot was clearly the seat of blending of the contiguous borders of the facial areas shown in Figs. 4 and 6.

the lower face, are represented. The remainder of the region for the movements of the face may be conveniently divided into thirds. The anterior third (*vide* Fig. 5), according to the investigations of Dr. Semon and myself, being the seat of representation of the movement of complete adduction of the vocal cords, together with associated movements of other parts of the throat. The hinder two-thirds (*vide* Fig. 6)

FIG. 6.

Representation of the lower face and floor of the mouth.

of the lower portion of the facial region is the seat of the representation of opening and shutting movements of the mouth with protrusion and retraction of the tongue and the floor of the mouth (Ferrier, Schäfer, and myself). In accordance with what has been said before, it is to be clearly understood that the areas of representation of these movements are functionally concentrated in the parts of the facial region indicated, but that each blends with the areas surrounding it, there being no sharp line of demarcation between them.

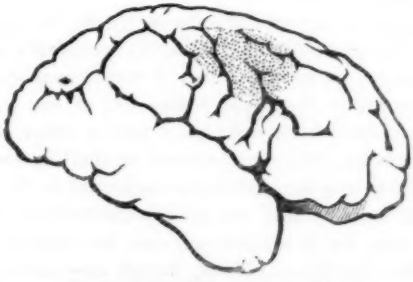
The next area in topographical order is that for the upper limb. The movements of the upper limb are so highly specialized in monkeys and in man as to occupy an extensive area of cortex in their representation, thus the movement in the upper limb—*i. e.*, of one segment of it or another can be elicited by irritating any part of either of the ascending convolutions from the line just mentioned as limiting the upper border of the facial region to a line continuing backward in the direction of the superior frontal sulcus. And yet the representation of the upper limb does not stop here, for it is continued over the superior frontal sulcus into the superior frontal convolution, though here, as we shall later see, every movement of it,—*i. e.*, the upper limb—is synchronously accompanied by contraction of the lower limb. Anteriorly, the upper limb region extends into the middle frontal gyrus for about its posterior fourth; the anterior half of this forward extension being also blended with the representation of the head and neck.

Now this very extensive and important area has recently been analyzed in minute detail by Dr. Beevor and the writer,[1] and what has just been stated is the embodiment of the results thus obtained. And in thus summarizing the details, it may be expedient to call to mind that the object of the present paper is simply to show clearly which parts of the limbs are most represented in which parts of the area; or, to use more popular language, to demonstrate which are the "centres" of the movements of those parts. The nature of the differences of the movement of such parts, though extremely important, is yet subordinate to the question of the *primary* representation of the parts moved when the practical needs of the diagnostician are considered. The first thing to be done, therefore, is to show the degree to which the various segments of the limb are represented in the area.

FIG. 7.

Representation of the shoulder.

FIG. 8.



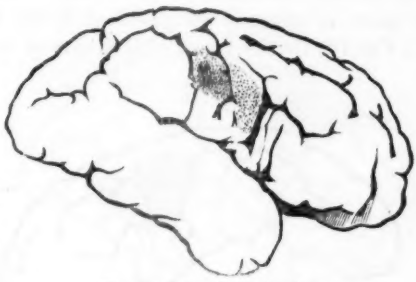
Representation of the elbow and wrist.

Most briefly the distribution of the parts amounts to this: the shoulder is centred in the upper part of the area, the elbow next below and pos-

[1] Proc. Roy. Soc., 1886.

teriorly, the wrist next below and anteriorly, the fingers next below and anteriorly, the thumb lowest and posteriorly. In other words, the pri-

FIG. 9.



Representation of the thumb.

mary representation of (*vide* Figs. 7, 8, and 9) the various segments of the limb is parallel to their anatomical arrangement—viz., from above downward. But another fundamentally important consideration here intervenes and gives a very definite character to the representation of the upper limb. This is the fact recognized by Dr. Beevor and the writer, that the elbow and wrist are hardly ever the seat of primary movement alone. The wrist is, of course, frequently the seat of primary movement, as may be seen in the accompanying diagram, but the existence of its own primary movement is evidently conditioned by the necessities of the never absent associated movement of the digits. The elbow very rarely ever moved primarily in association with other parts.

Viewing, on the other hand, the *movements* of the limb as a whole, we find that there is hardly one in which the elbow and wrist do not take part. Consequently, we conclude that these central joints are subordinate and that too, to the shoulder on the one hand and to the digits on the other. Finally, we have represented most briefly by (*vide* Figs. 7, 8, and 9) diagrams borrowed from the paper before referred to, the relative degree to which the various joints are represented in the upper limb area; the darkest shading signifying the most intense representation, or, as it would be popularly termed, the centre for the movement of that joint. It is advisable to point out here, that the transference of the results obtained by experimental investigation of the cortex of the monkey's brain, to translate the symptoms arising from irritative lesions in the human cortex, is very exact and reliable. Nor is this to be wondered at, since, as we are all of us aware, the movements of the upper limb in the monkey and in man are nearly identical. Confirmation of the truth of this statement is furnished by three cases of cerebral tumor from which I have successfully removed the growth, localizing the same

by the aid of the rules given in this paper. The situation of the lesion in each case, together with the primary movement elicited by the irritative effect of the same, is given in the accompanying diagrams (*vide* Figs. 10, 11, and 12), the primary movement in these cases meaning, of course, the first tonic spasm in epileptic fits produced by the lesion. In one case (Case IV., Fig. 10) the fits began with flexion of the shoulder, the

FIG. 10.

Case IV.

remaining segments of the limb being affected in order from above down, while finally the leg and face became affected. At the time of operation there were absolute hemiplegia and coma, both of which were relieved by removal of the tumor, which weighed four ounces and clearly grew in the corona radiata toward the cortex. Full details will shortly be published. In another (Case II., Fig. 11) the fits began in the

FIG. 11.

Case II.

thumb. The case is fully described in the *Brit. Med. Journal* for October 10, 1886. In the third a diffuse tumor (Case X., Fig. 12) invaded the shoulder region and caused constant clonic spasm of the shoulder- and elbow-joints, besides severe fits beginning in the shoulder. Full details

will soon be published. The confirmation of the accuracy of the experimental diagnosis really rests, of course, upon the fact of the tumor, etc., being found at the time of operation exactly where it was before determined to be.

FIG. 12.

Case X.

Leaving now the areas for the upper limb, and crossing therefore the superior frontal sulcus, we come first into a region where the representation of the upper limb and that of the lower limb are absolutely blended. This condition exists most markedly in the hinder sixth of the superior frontal gyrus abutting on the upper end of the ascending frontal (*vide* Fig. 13). This latter portion of cortex, however, really forms an inte-

FIG. 13.

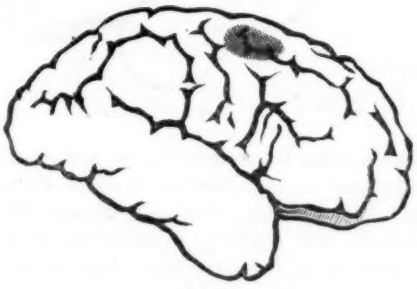
Reproduction of the combined synchronous action of both limbs.

gral part of the lower limb area, especially the same extending back behind the upper end of the fissure of Rolando into the so-called parietal lobule, which is nothing more than the upper part of the ascending parietal gyrus. This area of combined action of the limbs is a very remarkable one. The movement of the upper limb, which, be it remembered, is absolutely synchronous with that of the lower, consists primarily and essentially in what is known to anatomists as flexion of the

shoulder, in which movement the humerus is brought forward in a plane parallel to that of the middle line of the body. Consequent upon this movement of the shoulder the elbow is also extended. The movement represented in this region, according to Dr. Ferrier, *Functions of the Brain*, 2d ed., p. 481, are "various complex movements of the arms and legs, such as are concerned in climbing, swimming," etc.

Dr. Beevor and myself are about to publish a minute analysis of all this region, the function of which is so interesting as well as important. The representation of this combined movement of the limbs is shown in Fig. 13. Further, a case of traumatic epilepsy (Case I.,[1] *vide* Fig. 14),

FIG. 14.



Case I.

in which I freely removed a thick, fleshy, congested scar which penetrated an inch into the substance of the hemisphere, exemplified this localization of function, since the primary movement in the epileptic fit commenced in the complicated manner just indicated, the lesion being situated at and around the hinder end of the superior frontal sulcus.

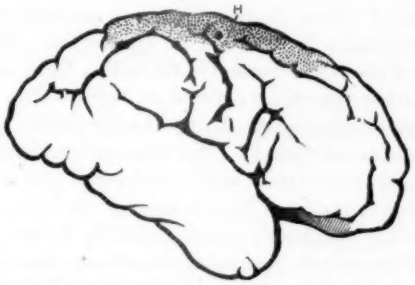
In a similar case, though not so perfectly limited (Case X., *vide* Fig. 12), in which I removed a four ounce tumor from this same region, a similar primary combined movement of both limbs was observed; additional information for localization purposes, however, being supplied by the fact that more recent involvement of the shoulder area was producing constant clonic spasms of the upper segment of the upper limb.

We may now leave the topographical diagnosis of lesions along the line of the ascending frontal gyrus, except as regards its summit—*i. e.*, immediately in front of the upper end of the fissure of Rolando. Here, as has just been remarked, commences the representation of the lower limb only (*vide* Fig. 15), and the primary movement of this part is that of the hallux. This functional representation is continued over the margin of the hemisphere into the paracentral lobule (Schäfer and the

[1] Vide British Medical Journal, October 10, 1886, for details.

writer), but the especial determination of the representation of the hallux will be fully described in a forthcoming paper by Dr. Beevor and the writer. Meanwhile, as the following case shows, advantage was taken

FIG. 15.



Representation of the lower limb. H. Focus of representation of the hallux (Beevor and writer.)

of the knowledge gained by the incomplete investigation to diagnosticate the situation of a cortical lesion and, as it proved, successfully. I owe the opportunity of seeing and treating the case to the kindness of my friend Dr. Savill, medical superintendent of the Paddington Infirmary.

Case VII., a navvy, was struck on the head with a pair of tongs eight or nine years ago, while intoxicated, no obvious injury save a scalp wound being produced. Traumatic epilepsy resulted, the primary movement consisting in flexion of the hallux followed by the gradual flexion of the rest of the lower limb and that followed by successive invasion of the rest of the body in the usual order. The fits, however, returned with increasing violence and e came under the care of Dr. Savill two years

FIG. 16.

Case VII.

later. When the writer saw the patient the fits were of the same character as heretofore. The skull having been uninjured by the accident, the diagnosis was made of a cicatricial lesion situated (*vide* Fig. 16)

about the upper end of the fissure of Rolando invading the upper end of the ascending frontal gyrus. On freely opening the skull and dura mater a dense and cystic cicatrix was found at this spot and almost completely removed (a small portion had to be left behind in consequence of the patient, an alcoholic subject, collapsing at this stage of the operation, rapid completion of which, however, effected his recovery). Since a week after the operation he has had no further fits. This case illustrates the truth of the representation of the hallux being situated at this point. In a further case twice referred to before (Case X., Fig. 12), recently (five weeks ago) operated upon by the writer, a tumor (also weighing four ounces, see Case IV.) was removed and with it the cortex in front of the upper end of the fissure of Rolando. The only permanent complete paralysis in the lower limb is that of the hallux. The representation of the lower limb only was described by Ferrier as situated in the upper part of the ascending parietal gyrus, the so-called parietal lobule. As just mentioned, the representation of the lower limb was also found by Schäfer and myself to be continued over into the mesial surface of the hemisphere. This very important region and function being the subject of further investigation still incomplete, must now be left in order to complete the discussion of the function of the posterior border of the so-called motor region by glancing, in way of review, at the function of the ascending parietal gyrus, while as has just been stated, the upper portion of the gyrus forms part of the area for the lower limb only. It was found by Dr. Beevor and myself (*Proc. Roy. Soc.*, 1886) that the shoulder (adduction with retraction) was next slightly represented in the superior parietal lobule, viz., in the horizontal line of the superior frontal sulcus continued backward. Further, that the rest of the gyrus as far as the lower end of the intraparietal sulcus was the seat of representation (partly combined) of the elbow and wrist in the upper third—*i. e.*, of the arm area and of the thumb and index in the remainder, together partly with the wrist and elbow except at the lowest point, see Figs. 8 and 9, which was reserved for the movements of the thumb.

We are now left with the consideration only of the representation of the head and neck and eyes.

As indicated by Ferrier, the area of representation of these parts occupied almost solely the middle frontal gyrus, and this, no doubt, is the focus of representation of the movement of the turning of the head and eyes to the opposite side, but a minute analysis (by Dr. Beevor and myself) to be published shortly, will show that a much more extensive representation as indicated in Fig 17 exists.

It must be left, for the present, an open question as to how far the representation of this important and interesting conjugate movement extends *forward* in the frontal lobe. A definite answer can only be given when the homologies between the sulci and the frontal lobe in the

Macaque monkey and man have been thoroughly determined. That this area of function is continued over the margin of the hemisphere into the marginal convolution, has already been shown by Professor Schäfer and myself. (*Proc. Roy. Soc.*, 1885.)

FIG. 17.

Representation of the head and neck together with conjugate deviation of the eyes

In every instance the head and neck are turned to the opposite side, and in some parts there is produced at the same time or later, conjugate deviation of the eyes.

So far, scarcely any mention has been made of the topography of representation of the other trunk muscles, neither has notice been taken of the movements of the organ of special sense, observed by Dr. Ferrier on exciting those portions of the cortex which he deemed to be the perceptive centres of those special senses. It will be remembered that the scope of this paper does not admit of a discussion of these latter observations.

As regards the trunk muscles, much might be said, but reference for detail is invited to the above mentioned paper in the *Proc. Roy. Soc.*, 1885. It is, however, worth while pointing out, psychologically speaking, that there is scarcely ever performed a highly purposive act by the trunk muscles only. The movements of the trunk are simply subordinate to the purposive movements of the limbs, and consequently we should not be surprised to find, as is the case, how extremely small a portion of the cortex is sufficient for primary representation of this part of the body. An illustrative case of the position in the human brain of the areas we have just been considering, is that of Case III., in which a man had been the victim of traumatic epilepsy for many years due to a small punctured fracture of the vertex of the skull, the said fracture being demonstrated externally by a minute depression three or four millimetres broad. The puncture had caused splintering of the inner table, laceration of the dura mater, and partial destruction of the subjacent cortex, so that at time of operation (eleven years later) there was found a rough ring of bone on

the inner surface of the skull around the centre of the fracture, from which a sharp and corrugated fragment one cm. long by five mm. broad projected downward together with a flap of entangled and torn dura mater into the wall of a small cystic cavity in the cortex just above the junction of the middle and posterior thirds of the superior frontal sulcus. This fairly extensive lesion (*vide* Fig. 18), which was freely removed

Fig. 18.

Case III.

(the result being cure of the epilepsy), was thus situated at the point of meeting of the area for the muscles of the trunk, of the area for raising with protrusion of the upper limb, and of that for turning the head and eyes to the opposite side of the body. The existence of such a lesion was diagnosticated from the fact that the course of events in the epileptic fit began with an aura of contraction of the abdominal muscles, this was followed by turning of the head and eyes to the opposite side, and then there occurred the raising of the upper limb. The exemplification of the topographical relations of these centres was thus faithfully demonstrated.

Conclusion.

As expressed at the outset, the object of this note was simply to discuss the methods employed by the writer in topographical diagnosis of disease of the so-called "motor" region only of the cortex cerebri, and, consequently, nothing more than a mere *résumé* of the facts which have been found useful to bear in mind has here been attempted.

Indeed, a very considerable branch of the subject of cerebral localization has only been glanced at, namely, the localization of the representation of the various movements of the joints—the representation of flexion and extension respectively, etc. The commencement of the consideration of this division of the subject is contained in the papers by Dr. Beevor and myself, and to these reference must be made, as, owing to the novelty of the facts, only cautious use of them for diagnostic pur-

poses is possible, and for this reason no further examination of this point has been made in this paper.

Perhaps the peculiarly wide interest attaching to the subject itself will be considered an adequate cloak for the bareness with which the said facts have been presented.

THE DIRECT ACTION OF ATROPINE, HOMATROPINE, HYOSCINE, HYOSCYAMINE, AND DATURINE ON THE HEART OF THE DOG, TERRAPIN, AND FROG.

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The alkaloid "atropia" was discovered about fifty years ago by Mein, Hesse, and Geiger. Since that time a host of experimenters have been engaged in the investigation of the action of this drug.

So difficult and perplexing, however, has been the study of its physiological properties, that more than half a century has elapsed without bringing the question to a final or generally satisfactory issue, notwithstanding the fact that many of the most prominent physiologists of the present day have been more or less engaged in grappling with the problem.

A perusal of the unusually rich literature of the subject, with its numerous controversies, bears, indeed, ample testimony of the great difficulty which the interpretation of even the most simple physiological phenomena may, at times, present, and points out the many dangers of forming erroneous conclusions from apparently the most precise and accurately performed operations. So far as the action of atropia on the heart is concerned, the best authorities still differ in about the following points: (1) That its action may be fully explained by assuming that a paralyzing influence is exerted on the terminal filaments of the pneumogastrics; (2) that atropia at first stimulates and then paralyzes these filaments; and (3) that it not only paralyzes the terminal filaments of the pneumogastrics, but also stimulates the vasomotor apparatus of the heart.

From some of my former experiments with atropia on the heart and bloodvessels of cold-blooded animals, I was led to conclusions which differ materially from those which are generally accepted by the majority of authors.

The results thus obtained seemed to point clearly to the fact that both the inhibitory and vasomotor apparatus of the heart became excited under the influence of atropia. The reduced ventricular rate fol-

lowing the increased rate was thought to be the result not only of the beginning of exhaustion of the musculo-motor apparatus from over-stimulation, but also of a still existing excitation of the inhibitory apparatus of the heart. This stage of atropine poisoning, however, is shortly followed by diastolic arrest, especially in warm-blooded animals, and to suppose that the inhibitory nerve-apparatus of the heart is still in a state of excitation immediately before diastolic arrest is produced as a consequence of musculo-motor exhaustion due to previous over-stimulation by atropia, would be equal to assuming that the inhibitory nerve-apparatus had never been paralyzed at any time before the death of the whole heart, but, on the contrary, continued in an excited state until the last; in other words, the normal influence of the inhibitory nerve-apparatus over the heart's action is merely inhibited by the over-excited condition of the musculo-motor apparatus and continues inhibited until the latter shows signs of exhaustion.

This view of the subject being clearly opposed to most of the at present received opinions, and the best authorities still differing greatly among themselves, it was our purpose to extend and enlarge the then limited material from which these conclusions had been drawn, and investigate the action of the entire atropine group on the heart of both cold- and warm-blooded animals. It is hoped that the results of these investigations may prove to be a useful addition to our knowledge of the physiological properties of atropine and its allies, not only on the heart but also with regard to its general action.

The method which was employed in experimenting on the frog and terrapin having already been given in detail in some of the previous papers published in this journal, I need here only mention the various steps for the successful isolation of the mammalian heart according to Martin's method, at the same time referring those more especially interested to the more detailed account published by Prof. Martin himself in the *Transactions of the Royal Society*, Part ii., 1883.

Isolation of the Heart of the Dog.—The animal having been placed under the influence of morphia, is fastened to a dog-holder, tracheotomy is performed and a canula introduced into the trachea. The external jugular vein is then dissected out and a canula filled with normal salt solution introduced with its open end pointing toward the heart. Through the latter canula about half a drachm of a one per cent. solution of curare is injected, after which injection artificial respiration is commenced. The vagi are now found and carefully divided. Canulas are introduced into the cardiac end of both common carotids, the arteries being clamped on the cardiac sides of the canulæ. The first two pairs of costal cartilages are now cut away together with the small piece of sternum which they embrace. Then the two internal mammary arteries are ligated just as they pass forward from the subclavians toward the breast-bone. The whole front and sides of the thorax are now cut

away and the right subclavian artery dissected out and tied just above the point where it separated from the common carotid. The superior vena cava is next prepared and a ligature placed loosely around the vessel for subsequently occluding it and tying a canula into its cardiac end.

Proceeding now to the left side of the chest, the subclavian artery of that side is ligated, and, the left lung being gently held aside, the arch of the aorta is isolated and cleared just beyond the origin of the left subclavian; a strong ligature is placed loosely around the vessel ready to be tightened. The azygos vein is next tied, and a ligature placed loosely around the inferior vena cava just as it appears above the diaphragm. Finally, a canula, previously filled with warm blood, is tied into the cardiac end of the superior vena cava, and the animal is prepared to be transferred into the warm, moist chamber in which it is to remain during the experiment.

The canula in the superior vena cava is at once connected with the common outflow-tube of several Mariotte's flasks, which contain the blood of proper temperature intended to feed the heart. The clamps are removed from the carotids, their canulas connected with the outflow-tube, which communicates with a mercury manometer writing on a continuous paper roll. The ligatures, which were but loosely placed around the aorta and inferior vena cava, are now tightened; the heart is washed out for a few moments with the blood from the Mariotte's flask until it is free from clots, and at last the outflow-tube is adjusted so as to secure the proper pressure for the normal working of the organ. The temperature of the circulating fluid may be read off at any time from the thermometer placed into the common outflow-tube.

The remainder of the apparatus consists in a warm, moist chamber, which must be large enough to accommodate the animal on the holder as well as the feeding flasks. The supplying flasks stand on a platform which can be raised or lowered according to the requirements of the particular case. The height of the bottom of the outflow-tube above the heart of the animal is referred to in the experiments as the venous pressure. This pressure, after once being adjusted, generally remains uniform throughout an experiment, and is the same for all the flasks. The outflow-tube, which is connected with the two common carotids, and from the end of which the blood pumped around flows out, and may be measured at stated intervals, is raised to a height which is deemed sufficient to maintain a normal pressure in the coronary arteries. Everything being in readiness, observations are begun a few minutes after the heart has performed normal work.

The drugs which were employed in these investigations came from the firm of Parke, Davis & Co., of Detroit, Mich. Hyoscyamine, hyoscine hydrobromate, and daturine were manufactured by the firm; the sul-

phate of atropine and homatropine hydrobromate had been obtained from Merck's establishment.

ATROPINE GROUP.—Chemically speaking, the remedies belonging to the atropine group, so-called, as atropine, daturine, hyoscyamine, and hyoscine, are probably all identical. Of late their chemical composition has been investigated more especially by Ladenburg, whose researches, however, according to Harnack,[1] have not as yet led to entirely satisfactory results. They all possess the common formula, $C_{17}H_{25}NO_3$, and have been found to consist of a basic tropine or pseudo-tropine, $C_8H_{15}NO$, and tropic acid, $C_9H_{10}O_3$, which has been artificially produced by Ladenburg and Rugheimer.

By boiling these alkaloids with acids or alkalies, they are decomposed into tropine and tropic acid. By the substitution of tropic with other acids, Ladenburg has succeeded in producing certain semi-artificial substances, which he has termed "tropëines."

Atropine is found in atropa belladonna, datura stramonium, hyoscyamus niger, and duboisia myoporoides. Daturine is mentioned as being a mixture of atropine and hyoscyamine. Hyoscyamine is derived from the same plants as atropine, and, like it, may be split up into tropine and tropic acid, but these products were formerly known as hyoscine and hyoscinic acid. Hyoscine is obtained from hyoscyamus niger, but may also be derived from hyoscyamine; it is much more difficult of crystallization, is isomeric with hyoscyamine, and decomposable into pseudo-tropine and tropic acid.

For hyoscine, Harnack has proposed the name of "Sikeranine," on account of the term hyoscine having formerly been applied to one of the products of decomposition of hyoscyamine. Homatropine is one of the semi-artificial tropëins obtained by the action of amygdalic acid on tropeïne, thus producing *oxytoluglytropeïn*.

So far as their action is concerned, that of atropine and hyoscyamine is supposed to be identical, the two drugs differing only in their effects upon the central nervous system. Hyoscine is said to act, in some respects, stronger, and homatropine, in all respects, weaker than atropine. Tropine is said to have no effect on the pupil, and in the experiments made with some of the semi-artificial atropines (tropëines), where tropic acid has been replaced by other acids, the effect upon the pupil was found to be either wholly negative or very much modified. These observations are of considerable importance, for if, as Gaskell maintains, the dilatation of the pupil is an active phenomenon, due to stimulation of inhibitory nerve-structures, a close connection between the action of the tropic acid molecule contained in atropine and stimulation of inhibitory nerve-structures, seems thereby clearly pointed out. The undoubted double action of atropine stimulating, as we believe, both

[1] Lehrbuch, T. Arzneimittellehre, etc.

inhibitory as well as vasomotor nerve-elements, may yet find a satisfactory explanation through a careful study of the relation existing between its chemical constitution and its physiological action.

LITERATURE OF THE PHYSIOLOGICAL ACTION OF ATROPIA ON THE HEART.—According to Dr. Lauder Brunton, atropia paralyzes the inhibitory nerve-ganglia. On page 48 of his work on *Pharmacology*, he states that both atropia and curare completely paralyze the motor or efferent nerves; but, while a very large dose of curare is required to paralyze the cardiac and vascular nerves, a very small dose suffices to paralyze those going to the muscles. On the other hand, an enormous dose of atropia is required to paralyze the nerves going to the muscles; while very small doses are sufficient to affect the nerves of the heart and of other involuntary muscles; so that we get rapid circulation, dilatation of the pupil, and restless delirium. On page 53 of the same work, we find it mentioned that atropia, in very minute doses, renders the pulse slow; that larger doses make it exceedingly rapid; and still larger doses render it slow again. The accelerator ganglia are said to remain uninfluenced by the drug. In the opinion of H. C. Wood and others, the latter ganglia are decidedly stimulated by atropia; and Dr. Roberts Bartholow, in the fifth edition of his treatise on *Materia Medica and Therapeutics*, page 435, states "that in some subjects a decided slowing of the heart takes place immediately after the administration of a considerable dose of it (hypodermatically), and in all, most probably, an instantaneous retardation of the pulse-rate; but a very decided rise in the number of pulsations quickly follows." Bartholow, like Wood, believes that atropia not only paralyzes the filaments of the vagus, but also stimulates the cardiac accelerator nerves.

The question naturally arises, How are we to account for this primary slowing of the heart's action which follows the administration of certain doses of atropia? Is it produced by the stimulating influence which the drug exerts upon the vagus-centre, or upon the peripheral filaments, or both? In the work of Dr. Lauder Brunton, already referred to, we find atropia, hyoscyamine, and daturine enumerated among those substances which are capable of stimulating the vagus-centre in the brain, but which paralyze the inhibitory ganglia within the heart.

The peculiar action of atropia might, therefore, be easily explained by its power of stimulating the vagus-centre. It has been experimentally proven by injecting atropine into the carotids, in which case it reaches the brain before it does the heart, and an invariable slowing has been found to take place when the drug is thus administered. But when atropia is administered hypodermatically, as it was in Bartholow's cases, it would naturally reach the heart before it would the brain, and should, accordingly, paralyze the terminal filaments of the vagi in the heart before it could stimulate their centres in the brain. In this manner, however, no slowing of the heart's action could take place, for after the

terminal filaments of the vagus are once paralyzed, no amount of stimulation of its centres in the brain would produce the slightest effect. The view, therefore, which attributes to atropia a like action would seem clearly insufficient to account for all the phenomena observed.

Nothnagel and Rossbach[1] explain the phenomena as being due, not only to an excitation by atropine of the vagus-centres in the brain, but also to a similar influence on its terminations in the heart. According to these authors, the administration of large doses of atropine in man, the rabbit, and the frog, is always followed by a transient slowing of the pulse-rate, which is usually short in man, but which may at once culminate in diastolic arrest in other animals. These same authors further state it, as the result of numerous experiments, that the initial retardation is quickly followed by an acceleration of the pulse-rate, which may become from twice to three times that of the normal; they believe that finally we have paralysis of the inhibitory portion of the vagus nerves, so that their stimulation produces acceleration, rather than slowing.

This explanation by Nothnagel and Rossbach met with great opposition on the part of Harnack, according to whom the smallest doses of atropine produce paralysis of the inhibitory ganglia of the heart in warm-and cold-blooded animals alike; large doses, he said, paralyze the heart itself, but have a slightly irritating influence on it before paralysis occurs. The slowing of the heart's action is explained by Harnack as due to the paralyzing influence of atropia on the heart itself. Harnack is very decidedly against the view which admits that atropia stimulates the vagus in the heart; he even denies the correctness of the explanation given by Gnauck for the primary slowing in the heart's action produced by hyoscine as being due to a direct stimulation of the inhibitory ganglia by this drug.

The controversy seems not yet closed on this all-important point, although the majority of physiologists in Germany incline toward the explanation of the primary slowing given by Nothnagel and Rossbach, while American and English as well as French writers appear as yet slow in accepting it.

According to our conception of this question, there is no point in the whole history of the physiological action of atropia, the decision of which is of greater importance. Unless we know whether atropia paralyzes or stimulates the terminal filaments of the vagus, and under what conditions it exerts its influence, the administration of the drug cannot be said to rest on anything like a scientific basis. In reviewing the literature of the subject, we find the best authorities almost equally divided. The difficulty, therefore, of the correct solution of the question seems fully equal to its importance. No matter which of the two opposing views we may hold, we find ourselves supported by experimental evidence

[1] Lehrbuch J. Arzneimittellehre, etc.

of the first quality, and neither is easily set aside. Thus the well-known experiments of Schmiedeberg and Koppe on the antagonism of atropine and muscarine, and those of Fraser on the antagonism between atropine and physostigmine, which latter were repeated and confirmed by Lauder Brunton, are, to all appearances, so strikingly exact as to bear almost incontrovertible testimony of the fact that atropine paralyzes, and at no time stimulates, the terminal filaments of the vagus. Still it must also be admitted that the fact that atropine antagonizes muscarine-standstill need not necessarily imply that atropine paralyzes and muscarine stimulates the inhibitory ganglia, and that all the phenomena observed depend absolutely on such action. Again, the fact that physostigmine restores the normal function of the vagus over the heart after the latter had been atropized, and artificial stimuli could not be conveyed to it through its fibres, does not necessarily imply that atropia had paralyzed and physostigmine restored the normal function of the inhibitory ganglia of the heart, and our experiments will show that even without physostigmine the function of the terminal filaments and ganglia of the vagus may be fully restored after atropization. No matter what the explanation may be, we may divide the action of atropia on the heart into three distinct stages, namely: (1) The primary slowing, followed (2) by an acceleration, which again is succeeded by (3) a second slowing, which may be either followed by a return to the normal, or terminate in diastolic arrest. These three well-marked stages have been observed by all those who have subjected the drug to careful experimentation. The slowing following the stage of acceleration has been commonly observed in all animals, since von Bezold and Blœbaum first called attention to it; and Mitchell, Keen and Morehouse, and other clinical observers have noticed its occurrence in man, in whom, as a rule, it returned to the normal. This stage, therefore, must be explained, as well as the first two stages, and exhaustion alone will not sufficiently account for it. In presenting the experiments, only those will be given which are typical.

Exp. XXVI.—May 19, 1886. Small adult dog. Heart isolated at 3.20 P. M. under morphine and curare. Venous pressure 22 c. m. Arterial pressure equal to 140 m.m. mercury. Normal nutrient: defibrinated calf's blood. Atropine sulphate used in the proportion of 1 grm. dissolved in 4000 of calf's blood.

Time P. M.	No. of beats in 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	The circulating fluids were supplied to the heart at the time mentioned on the same line in the first column.
3.22	80	100	35°	Under normal blood.
23	80	100		
24	80	100		
25	81	102		
26	81	105	35	On atropized blood.
27	81	100		
28	66	85	...	On normal blood.
29	60 : 30	40	...	Auricles contracting twice, ventricles once.
30	60 : 30	0	...	Heart's action very irregular, pressure going down rapidly. Arrested in diastole; slight kneading still followed by solitary contractions.
31	...	0	35	

Exp. XXVII.—May 19, 1886. Small adult dog. Under morphia and curare. Heart isolated at 4.16 P. M. Venous pressure 22 c. m. Arterial pressure equal to 140 m.m. mercury. Normal nutrient: defibrinated calf's blood.

Time P. M.	No. of beats in 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	The circulating fluids were supplied to the heart at the time mentioned on the same line on the first column.
4.20	74	110	36°	Under normal blood.
21	74	112		
22	73	108		
23	73	108		
24	73	106	36	On atropized blood, 1 : 8000.
25	70	120		
26	67	126		
27	71	128	...	On normal blood.
28	70	136		
29	70	124	36	On atropized blood, 1 : 8000.
30	70	128		
31	65	138		
32	66	144		
33	67	136		
34	68	130	36.5	
35	68	126	...	On normal blood.
36	70	116		
37	72	102		
38	74	102	36.5	
39	72	102	...	On atropized blood, 1 : 8000.
40	72	130		
41	72	128		
42	71	130		
43	73	130		
44	73	90		
45	70 : 35	54	...	Auricle contracting twice, ventricle once.
46	62 : 28	20	...	Heart action irregular; distended.
47	...	0	37	Stopped pumping wound: pressure sinks; arrest quickly takes place; cutting away pericardium negative; slight kneading still followed by solitary contractions.

Exp. XXX.—Terrapin, 1605 grms. Calf's blood and Ringer's saline (1 : 1½). Inflow canulas in left superior vena cava and inferior vena cava. Outflow canulas in right aorta and pulmonary artery. Venous pressure 4 c. m. Arterial pressure 30 c. m.

Time P. M.	Rate per min.	Work in c.c. per min.	Temp. Cent.	
2.24	30	55	20°	
27	31	55		
32	31	56		
35	31	56	...	On atropized blood, 0.04 : 100 c. c.
36	31	52		
37	31	53		
38	30 : 15	56	...	Auricles contract twice to ventricles once.
39	30 : 15	55		
40	30 : 15	52		
41	30 : 15	52	20	On normal nutrient.
43	30 : 15	56		
44	30	57		
50	30	53		
57	32	52	...	On atropized blood, 0.03 : 100 c. c.
58	32	50		
59	31	49		
3.00	31	49		
03	30 : 15	?	...	Auricles contract twice, ventricle once.
05	30 : 15	53		
10	30 : 15	52		
15	31	53	20	
20	31	55		
25	31	54		
30	31	...	...	On atropized blood, 0.08 : 100 c. c.
35	31			
36	30 : 15	...	...	On normal blood mixture.
37	30 : 15			
38	30 : 15			
39	30 : 15			
40	30 : 15	20	...	Heart still in good condition. Experiment discontinued.

Exp. XXI.—May 12, 1886. Small adult dog. Under morphine and curare. Heart isolated at 2.38 P. M. Venous pressure 26 c. m. Arterial pressure 144

m. m. mercury. Calf's blood the normal nutrient. Homatropized blood used in different degrees of strength.

Time P. M.	No. of beats in 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	The circulating fluids were supplied to the heart at the time mentioned on same line in the first column.
2.49	81	146	35°	Under normal blood.
50	81	146		
51	81	142		
52	82	146		
53	82	148	35	On homatropized blood, 1 : 6000.
54	89	152		
55	86			
56	86	156	...	On normal blood.
58	82	150		
59	84	148		
3.00	86	144	36	
01	88	140	...	On homatropized blood, 1 : 6000.
03	88	164		
04	90	162		
06	89	173	...	On pure blood.
07	89	173	37	
08	90	175	...	On homatropized blood, 1 : 6000.
09	91	180		
10	90	178		
11	88	174		
12	90	.....	...	On normal blood.
13	90	.....	37	
14	90	144		
16	90	136		
17	88	130		
18	89			
19	88	128	...	On homatropized blood, 1 : 2000.
20	86	86	37.5	
21	84	74	...	On normal blood.
22	84	106		
23	84	114		
24	84	128	37.5	
25	84	140		
26	83	140		
27	85	140		
28	85	139	...	On homatropized blood, 1 : 4000.
29	85	120	38	
30	84			
31	84	120		
32	82	120		
33	83	120		
34	84	122	38	
35	84	124		
36	83	112		
37	82	106		
38	82	98	38	
39	82	96		
40	82			
41	81	94		
42	80	82	38	
43	80	82	...	On normal blood.
46	82	78		
48	82	77		
50	81	74		
51	81			
52	82	96	...	On homatropized blood, 1 : 4000.
53	84	80	38	
54	84	76		
55	83	70		
56	84	66		
57	85	56		
58	86	54		
59	87			
4.00	84	40		
01	84	32		
03	82	24	...	Beginning irregular heart's action.
05	76	10	...	Great distention, followed by arrest. Slight kneading followed by single, though ineffectual contractions.

In Experiment XXVI. very strongly atropized blood was used, and the effect produced by it was, accordingly, very marked. During the first five minutes of observation, while the heart was working under normal calf's blood of the temperature of 35° Cent., the rate kept at 80

to 81 beats per thirty seconds, and the amount of blood pumped round in half a minute varied from 100 to 105 c. c. From 3 h. 26 m. to 3 h. 28 m., judging from the quantity of blood which ran through the heart during these two minutes, the latter had been exposed to the influence of about 0.05 grm. of the sulphate of atropia. The rate was quickly reduced from 81 to 66 beats in thirty seconds, the work done from 105 c c. to 40 c. c. for the same period of time; then the heart's action became irregular, the auricles beating at the rate of 60 times to the ventricle 30 times, the work being *nil;* at last the action of the heart became still more irregular, the pressure suddenly went down, and diastolic arrest ensued, mechanical stimulation, however, still being followed by single, and not very powerful contractions. This is the typical result which follows the admission of strongly atropized blood into the mammalian heart.

In Experiment XXVII. atropized blood of only half the strength of that used in the preceding experiment was employed, and the result, as may be seen, is quite different. An increase, instead of a decrease, in the amount of work done may be noticed, accompanied by a slight decrease in the rate, followed by an attempt on the part of the latter to return to the normal. All this occurs while atropized blood is still circulating through the heart, but becomes much more apparent after this is withdrawn, and normal blood is again allowed to flow through. Finally, after repeated atropization, we obtain the effect of large doses of atropine on the heart, namely, rapid reduction of rate and work, irregularity in its action, and arrest in diastole.

In these, as well as in other similar experiments, after diastolic arrest was apparently complete, gentle kneading of the ventricle was still followed by contractions, showing that the muscular substance of the heart was still in possession of a certain amount of irritability.

In all the experiments made with homatropine on the mammalian heart, its effects were found to be identical with those of atropine used in very small doses. Its influence upon the inhibitory nerve-apparatus of the heart is decidedly less powerful than that of atropine, which is in apparent accordance with its effect upon the pupil, which is but transient when compared with that of atropine. Experiment XXI. has been selected to represent the typical action of homatropine on the mammalian heart, as well as that of very small doses of atropine. An examination of this experiment shows that during the first three observations which were made with homatropized blood, the rate is slightly increased, and the work done very considerably augmented. Homatropized blood of the strength of 1 : 2000, however, invariably reduces both rate and the work done, while when it is used in the proportion of 1 : 4000, or even less strong, it produces the opposite effect. Blood of this strength was kept circulating through the heart for 15 minutes, and, while no

increase in the rate or the work done was noticed, both were only very slowly and gradually reduced, the former from 85 to 80, the latter from 140 to 82 c. c. per 30 seconds. Atropized blood of the same strength in all the experiments made with it on the mammalian heart, never failed to produce diastolic arrest within three to four minutes. The most marked feature, however, in the effect produced by very small doses of atropine or medium doses of homatropine, is an acceleration in the heart's action, followed by a slowing, instead of, as is the case with the medium doses of atropine, at first a slowing, followed by an increase in the rate. This apparently contradictory result will be explained satisfactorily later on.

Experiment XXX. on the heart of the terrapin, represents but a portion of an experiment published elsewhere, but which, nevertheless, may with propriety be reproduced here, for the reason that it represents in a typical manner the effect produced by large drops of atropine on the heart of cold-blooded animals. The point which it is desirable to emphasize, is the reduction, by certain definite doses of atropine, of the rate of the ventricle, that of the auricles, though much weakened, remaining numerically unchanged. It happens, after atropized blood of about the strength of that used in this experiment has circulated through the heart a certain length of time, that there follows a period during which the rate of the ventricle becomes just half that of the auricles. This change in the ventricular rate comes on suddenly as a rule. After awhile, however, atropized blood being kept on, the ventricular rate is still further reduced, and, finally, diastolic arrest of the entire heart ensues. During this stage of atropization, the ventricle is from twice to three times its normal size, but the work done, in spite of the reduced rate of contraction, is generally increased. In some of my former experiments with regard to this point, published in the *Proceedings of the U. S. National Museum for* 1855, the work done by the heart during this stage is increased 100 per cent. Atropized blood being withdrawn and normal blood readmitted, the ventricle, after a short time, will be found to resume its normal number of contractions in as prompt a manner as it passed from the normal to the reduced rate. This singular phenomenon may be reproduced many times during the course of a single experiment, and the dose of atropine producing it, so graduated as to keep it up any desired length of time.

It is a remarkable fact, that very small doses of the drug never produce this effect. Atropized blood, mixed in the proportion of 1 : 10,000, may be allowed to circulate through the heart for several hours in succession, and no such result will follow, even if the heart, during that time, has been exposed to the influence of a much larger total amount of atropia than would suffice to produce it when used in a more concentrated form. Under these circumstances the rate is increased from three to five beats per minute, the size of the entire heart undergoes great

reduction, its systole is lengthened, its diastole correspondingly shortened, the work done greatly reduced in amount. This condition may go on until it almost resembles one of systolic arrest, the diastole becomes completely abolished, and no blood whatever is being pumped around. Small doses of atropine, therefore, produce an apparently opposite result from that which is produced by large doses, and this is a point upon which it is desired to lay particular stress in this connection.

Thus Bowditch and Luciani found the contractions both of the frog's heart containing the ganglia and of the apex alone, were rendered more powerful by atropine, while Gnauck, on the contrary, found that the contractions of the ventricle were diminished both by atropine and hyoscyamine. Kronecker and Schapiro believed that they had found that both these apparently contradictory results were correct, but at different temperatures. They state that when the temperature is low (70–80° C.) the ventricular contractions are enlarged by atropine, but diminished by it when the temperature rises above 15° C. We believe that this explanation is insufficient, if not entirely wrong. The phenomena observed by Kronecker and Schapiro depend entirely on the temperature of the heart, or the circulating medium, and have little or nothing to do with the action of atropine on that organ.[1] From the experiments which are here published, as well as elsewhere, it is, I think, clear that the difference in the character of the contractions observed by Bowditch and Luciani on the one hand, and Gnauck on the other, as to the effect of atropine on the heart, is a matter of *dose of the drug* rather than of temperature. In experimenting on the heart with circulating media of different degrees of temperature, it will be found that those of low temperature will cause a reduction in the rate as well as an increase in the size of the contractions, and *vice versa*. The heart, therefore, in this respect, and under the influence of blood of different degrees of temperature, behaves somewhat similar to what it does when under the influence of different doses of atropine, larger doses of atropine corresponding in their effect to circulating media of low temperatures, the smaller ones to circulating media of higher temperatures, and this, perhaps, explains the errors made by Kronecker and Schapiro.

EXP. XII.—April 29, 1886. Dog, 5400 grms. Under morphine and curare. Heart isolated at 4.35 P. M. Calf's blood. Venous pressure 16 c. m. Arterial pressure 138 m. m. mercury at start. Hyoscinized blood, 1 : 4000

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
4.39	85	75	40°	Under normal blood.
40	85	75		
41	85	75		
42	84	76		
43	85	78	40	On hyoscinized blood.
44	80	50		
45	78	34		
46	74	26	...	On normal blood.

[1] See the author's explanation of the influence of blood in different degrees of temperature on the heart of the terrapin.—Proc. U. S. Nat. Mus., 1885. Washington, D. C.

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
4.47	80	40	40°	
48	78	44		
49	78	64	...	On hyoscinized blood.
50	70	33	...	On normal blood.
51	74	30		
52	75	30	40	
53	75	30		
54	74	28		
55	73	26		
56	73	28	...	Arterial pressure fixed at 124 m. m.
57	73	30		
58	73	30	40	On hyoscinized blood.
5.00	67	...		
01	66	13	...	On normal blood.
03	65	24		
04	63	20		
05	63	...		
06	62	24		
08	60	28	40	On hyoscinized blood.
10	58	16		
12	58	8	...	On normal blood.
13	57	0		
14	56	0	...	Arterial pressure fixed at 100 m. m.
16	59	6		
17	64	4		
19	62	0	...	Stopped pumping wound; pressure sinking gradually.
20	60	0		
21	55	0		
22	53	0		
23	51	0	...	Heart greatly distended. Final arrest in diastole.

EXP. XI.—April 29, 1886. Dog, 4970 grms. Under morphine and curare. Heart isolated at 3.10 P. M. Venous pressure 18 c. m. Arterial pressure 150 m. m. mercury. Calf's blood. Hyoscinized blood, 1 : 6000.

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
3.16	95	86	38.5°	Under normal blood.
18	94	85		
20	95	85	39	On hyoscinized blood.
21	90	76		
22	86	62		
23	84	60	...	On normal blood.
24	90	56		
26	95	80	39.5	
28	96	76		
29	95	72		
31	94	71		
33	94	71		
34	94	68	40	On hyoscinized blood.
35	89	60		
36	88	50		
37	88	32	...	On normal blood.
39	86	...	40	
40	86	10	...	Pressure begins to go down.
41	85	0	...	Stopped pumping wound.
42	80	0	40	Heart in diastolic distention; arrest.

EXP. XXXI.—May 25, 1886. Small adult dog. Under morphine and curare. Heart isolated at 2.22 P. M. Calf's blood. Venous pressure 18 c. m. Arterial pressure 136 m. m. mercury. Hyoscinized blood contained 1 grm. of the drug in 800 c. c. of calf's blood.

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
2.31	86	60	35°	Under normal blood.
32	86	58		
33	88	60		
34	88	62		
35	88	65	35.5	On hyoscinized blood.
36	93	50		
37	92	53	...	On normal blood.
38	90	55		
39	94	70		
40	95	70	35.5	
42	97	68	...	On hyoscinized blood.
43	97	60		
44	99	24	...	On normal blood.
45	103	0	...	Stopped pumping wound.
47	0	0	36	Pressure rapidly sinking; arrest in diastole.

EXP. XXVII.—March 4, 1886. Terrapin, 890 grms. Beef's blood and Ringer's saline (1 : 1). Canulas as usual. Venous pressure 6 c. m. Arterial pressure 16 c. m. Hyoscinized blood (*a*) 0.03 : 100 c. c.; (*b*) 0.25 : 100 c. c.; (*c*) 0.5 : 100 of normal blood mixture.

Time P. M.	Rate per min.	Work in c.c. per min.	Temp. Cent.	
3.20	32	14	18°	Under normal blood mixture.
25	32	14		
30	32	14		
35	32	15		
40	32	15	18	On hyoscinized blood (*a*).
41	35	16		
42	33	16		
43	31	13		
44	31	12		
45	30	12		
46	30	12	...	On normal blood mixture.
55	32	20	19	
4.00	32	15		
03	33	17		
06	33	16	...	On hyoscinized blood (*b*).
07	32	15		
08	32	14		
09	31	11		
10	30	11		
11	28	10		
12	28	11		
13	26	11	20	
14	25	11		
15	25	10.5		
16	25	12		
17	25	13		
18	25	12.5	20	
19	25	12.5	...	On normal blood mixture.
20	25	12.5		
21	25	12		
22	25	13		
24	28	13		
28	29	15		
32	31	13		
36	32	14	...	On hyoscinized blood (*c*).
37	31	13		
38	30	11		
39	28	10		
40	26	10		
41	25	7		
42	24	7		
43	24	6		
44	24	5		
45	24	4		
46	23	3.5	...	Auricles largely distended; contractions barely perceptible.
47	23	3		
49	22	3	...	Heart's action getting to be irregular. Observations discontinued.
55	20	1	21	

In Experiment XII. on the heart of the dog, hyoscine was used in the proportion of 1 grm. of the drug dissolved in 4000 c. c. of defibrinated calf's blood. The first observation with blood of this strength shows a decrease in the rate of 9 beats in 30 seconds, or 18 beats per minute, and a total decrease in the work done of 52 c. c. per 30 seconds, or 104 c. c. per minute. The maximum reduction of both rate and work was reached after hyoscinized blood had run through the heart three minutes. Upon the readmission of pure blood, the rate went up to 80 per 30 seconds, or 6 beats, but finally remained at 78; the amount of work done was increased from 26 to 64 c. c. Hyoscinized blood being again turned on, for only one minute, the rate went down suddenly from 78 to 70 and the work done from 64 to 30 c. c. in 30 seconds. Pure blood now readmitted, though slightly increasing the rate, did not give rise to a corresponding increase in the work. During the entire experiment with hyoscine the

rate of the heart was reduced from 85 beats to 51 beats per 30 seconds, the temperature of the circulating blood varying 1° C., being 40° at the beginning and 39° at the end. The heart was finally arrested in diastole, the muscular walls still responding to mechanical stimulation.

In Experiment XI. hyoscine was used in the proportion of 1 grm. to 6000 c. c. of calf's blood. The effect which is produced on the rate is quite as decided as in the preceding experiment, while the work done does not experience the same amount of reduction.

In Experiment XXXI., in which hyoscine was used in the proportion of 1 : 8000, the result, as may be seen, is quite different. An increase instead of a decrease in the rate follows the admission of hyoscinized blood into the heart; the work, however, is slightly decreased. This is the usual result obtained with hyoscine used in this proportion. Out of three experiments including eleven observations, an initial increase in the work done was noticed only once.

In Experiment XXVII. on the terrapin we have an illustration of the effects of both large and small doses combined; the latter causing an increase in the rate and the amount of work done in a given time, the former giving rise to a decided decrease in both.

Comparing the effect of hyoscine with that of atropine on the heart, the great similarity with which both influence that organ must be apparent. The only difference which is noticed is a quantitative not a qualitative one. Both, no doubt, stimulate the vasomotor as well as the inhibitory ganglia and their nerve filaments. Atropine, however, seems to have a somewhat more powerful influence on the vasomotor portion of the nerve apparatus than hyoscine has; besides, hyoscine does not seem to stimulate the muscular substance to the same extent as is done by atropia. Both resemble each other in that larger doses are required to produce inhibitory excitation, and smaller ones only suffice to stimulate the vasomotor ganglia. As in the case of atropine, diastolic arrest is brought about by stimulation of the inhibitory nerve apparatus and the accompanying musculo-motor exhaustion.

Exp. VII.—April 27, 1886. Dog, 5445 grms. Under morphine and curare. Heart isolated at 3 P. M. Calf's blood. Venous pressure 15 c. m. Arterial pressure 134 m. m. mercury. Hyoscyamized blood, 1 : 4000.

Time P M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
3.08	60	80	34°	Under normal blood.
09	60	80		
10	63	75		
11	65	70		
13	70	65	35.5	
15	70	65		
16	70	60		
17	69	65	...	On hyoscyamized blood.
18	61	49	36	
20	60	35		
22	60	30	...	On normal blood.
23	70	22		
25	71	46		

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
3 27	72	44		
29	71	42	...	On hyoscyamized blood.
31	62	25		
33	57	15		
35	51	0	...	Stopped pumping wound; pressure going down quickly; great distention. Final arrest in diastole. Gentle kneading still followed by contraction.
38	48	0		

Exp. XXXII.—May 25, 1886. Small dog. Under morphia and curare. Heart isolated 3.40 P. M. Venous pressure 22 c. m. Arterial pressure 136 m. m. mercury. Calf's blood. Hyoscyamized blood 1 : 8000.

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
3.47	100	110	37.5°	Under normal blood.
48	100	108		
49	100	110		
50	100	112		
51	100	112	37.5	On hyoscyamized blood.
52	94	162		
53	92	158	...	On normal blood.
54	91	98		
55	91	100		
56	91	100	38	
57	91	100	...	On hyoscyamized blood.
58	91	110		
59	92	114		
4.00	92	118	39	On normal blood.
01	92	112		
02	92	102		
03	93	106	...	On hyoscyamized blood.
04	92	80	39	
05	92	68		
06	92	14	...	On normal blood.
07	100	0	...	Stopped pumping wound; pressure rapidly sinking. Diastolic arrest quickly followed.
08	102	0	39	

Exp. XL.—June 2, 1886. Small adult dog. Under morphine and curare. Heart isolated at 3.40 P. M. Venous pressure 22 c. m. Arterial pressure 150 m. m. mercury. Calf's blood. Hyoscyamized blood, 1 : 8000.

Time P. M.	No. of beats per 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	
3.44	92	140	40°	Under normal blood.
45	92	140		
46	93	140		
47	94	142	...	On hyoscyamized blood.
48	93	152	40	
49	93	148		
50	88	140		
51	88	138		
52	88	138	40.5	On normal blood.
53	88	132		
54	89	138		
55	90	146		
56	90	143	...	On hyoscyamized blood.
57	86	156		
58	91	148	41	
59	91	138	...	On normal blood.
4.00	92	140		
01	92	140		
02	93	142		
03	93	150	41	
04	93	156	...	On hyoscyamized blood.
05	90	164		
06	91	136	...	On normal blood.
07	92	100	...	Beginning irregularity in the rhythm.
08	92	0	41	Stopped pumping wound; arrest.

Exp. VI.—January 23, 1886. Frog, 110 grms. Beef's blood and Ringer's saline (1 : 1). Inflow canula in inferior vena cava. Outflow canulas in two aortic trunks. Venous pressure 4 c. m. Arterial pressure 12 c. m. Hyoscyamized blood, (*a*) 1 : 10,000, (*b*) 1 : 5000.

Time P. M.	Rate per min.	Work in c.c. per min.	Temp. Cent.	
4.00	35	9	18°	Under normal blood mixture.
05	35	9		
10	35	9		
15	35	9	...	On hyoscyamized blood (a).
17	40	9	18	
19	40	9.5		
21	38	11		
23	35	10		
25	35	10	18	
30	35	10		
35	33	10		
40	33	10	18	
44	30	9	...	On normal blood mixture.
46	34	9		
50	34	9		
55	36	8.5		
59	36	8.5	18.5	On hyoscyamized blood (b).
5.01	44	10		
03	41	9.5		
07	38	9		
11	35	8 5		
15	35	8	18.5	
20	35	8		
25	34	7 5		
30	34	7	...	On normal blood mixture.
35	31	7		
40	31	7		
45	35	8		
50	35	8.5		
55	35	9	19	Observations discontinued.

In Experiment VII. hyoscyamine was used in the proportion of 1 : 4000. During the first observation with hyoscyamized blood, the rate was reduced 9 beats per 30 seconds, and the work done was decreased from 60 c. c. to 30 c. c. for the same interval. Pure blood being now turned on, the rate promptly returned to the normal, the work, though increasing somewhat, did not again reach the normal amount. The result of the second observation with hyoscyamized blood was a reduction in the rate from 69 to 48 beats per 30 seconds and the work became nil. The heart, especially the ventricle, was largely distended, stopped pumping around, the pressure quickly went down and diastolic arrest followed.

In Experiment XXXII. hyoscyamine was used in the proportion of 1 : 8000. We notice here also a reduction of 4 beats in the rate during the first minute and of 3 additional beats per 30 seconds, during the following two minutes. The reduction in the rate takes place much more gradually in this experiment than in the preceding one, due to the diminished strength of hyoscyamized blood. The later observations show an increase in the rate. The work is increased in the beginning and decreased toward the end of the experiment when the heart is arrested in diastole.

In Experiment XL. we again find at first a decrease and then an increase in the rate due to hyoscyamized blood. This observation is of great importance, and throws considerable light on the character of the action of hyoscyamine on the heart. Hyoscyamine, like atropine, excites both inhibitory and accelerator nerves, the latter being influenced by comparatively small doses which, however, are themselves insufficient to affect the inhibitory apparatus. On the other hand, when the dose of

the drug, applied to the heart, happens to be sufficiently large to stimulate both these nervous structures alike, inhibitory stimulation becomes manifest before that of the accelerator nerves in the same manner as this occurs when electrical stimulation is applied. Hence the primary decrease, as due to the action of hyoscyamine, being followed by a subsequent rise in the rate of the heart.

Experiment VI. on the heart of the frog, shows an initial increase in rate followed by a decrease below the normal. Small doses invariably give rise to an increase in the rate, but if hyoscyamized blood is allowed to run through the heart for a longer time than is sufficient to produce the maximum increase, the rate begins to fall as under larger doses, so that, in this experiment, we have the effects of small as well as large doses. As a rule, the mammalian heart reacts much more promptly than does that of cold-blooded animals.

Exp. XIX.—May 11, 1886. Dog, 9750 grms. Under morphia and curare. Heart isolated 2.38 P.M. Venous pressure 16 c.m. Arterial pressure equal to 146 m.m. mercury. Calf's blood the normal nutriment. Daturine used in the proportion of 1 : 8000.

Time P. M.	No. of beats in 30 sec.	Work in c.c. per 30 sec.	Temp. of blood in Cent.	The circulating fluids were supplied to the heart at the time mentioned on the same line in the first column.
2.41	83	116	36°	Under normal blood.
43	83	115		
44	82			
45	82	115		
46	82	115	36	On daturine blood.
47	85	100		
48	86	100		
49	82	100	...	On normal blood.
50	85	100	36	
51	85	102		
52	89	104		
53	90	102		
54	92	102		
55	96	104		
57	96	110	...	On daturine blood.
58	97	94	37	
59	96	70	...	On normal blood.
3.00	94	70		
01	95	70		
02	96	90		
03	95	109		
04	96	109		
05	97	110	38	On daturine blood.
06	95	90		
07	95	75		
08	93	65	38	On normal blood.
09	93			
10	93	68		
11	93	70		
12	92	80		
13	91	...	38	
14	91	85		
15	91	90		
16	92	...	...	On daturine blood.
17	89	55	38	
18	88	50		
19	86	45		
20	84	20		
21	84	0	38	Heart's action becoming irregular; stopped pumping wound; great dilatation, followed by sudden arrest in diastole.

Exp. XXIII.—February 24, 1886. Terrapin, 960 grms. Beef's blood and Ringer's (1 : 1). Canulas as usual. Venous pressure 7 c.m. Arterial

pressure 18 c. m. Daturine blood, (*a*) 0.01 : 100 c. c., (*b*) 0.02 : 100 c. c., (*c*) 0.04 : 100 c. c.

Time P. M.	Rate. per min.	Work in c.c. per min.	Temp. Cent.	
3.00	35	25.5	...	Under normal blood-mixture.
05	35	26		
15	35	26		
20	36	25		
25	36	25		
30	36	24		
36	36	24	...	On daturine blood (*a*).
37	38	40		
38	36	47		
39	35	40		
40	35	32	...	On normal blood-mixture.
42	36	38		
50	36	38		
55	36	38		
4.00	36	37		
05	37	39		
10	37	40		
15	36	41		
18	36	40	...	On daturine blood (*b*).
19	38	45		
20	36	35		
21	36	35		
22	34	26		
23	33	25		
24	31	28	...	On normal blood-mixture.
25	31	37		
26	30	43	22.5°	
27	31	41		
29	29	45		
35	32	50		
40	33	40		
45	35	41		
50	36	40		
55	36	39	...	On daturine blood (*c*).
56	38	42		
57	34	37		
58	32	30		
59	30	27		
5.00	29	24		
03	24	20		
05	26	18		
07	26	18	...	On normal blood-mixture.
09	26	15	...	Auricles greatly distended; barely perceptible contractions.
15	27	22		
20	28	27		
25	29	28		
30	30	30	...	Auricles almost recovered.
35	32	33	...	Observations discontinued.

Three experiments were made with daturine on the dog's heart, from which No. XIX is selected as representing what occurred in all. Small doses cause a slight increase, large ones a decrease in the rate. Out of the ten observations with daturine, divided between three experiments, a slight increase in the work occurred but once on small doses, which, although giving rise to an increase in rate, as a rule, decrease the amount of work done.

As shown in Experiment XXIII. on the terrapin, a slight initial increase in the rate occurs every time daturine blood is admitted into the heart. The increase in the work amounts at times to 100 per cent., the decrease coming on only after daturine blood has been kept circulating through the heart for a long time, this being equal to the effects of large doses, which latter, when applied to the heart at once, always reduce the rate very considerably. In the terrapin the auricles seem to become paralyzed long before the ventricle does when weak blood has

been flowing through the heart for a long time. Strong daturine blood produces diastolic arrest of auricles and ventricle simultaneously.

Before discussing the phenomena as observed in the foregoing experiments, it will be necessary to review briefly some of the important fundamental points in relation to the innervation of the heart, more especially in the light of the more recent researches on the sympathetic nervous system by W. H. Gaskell.[1]

According to the views most generally received, the heart of both cold- and warm-blooded animals contains three kinds of nervous ganglia, endowed with different functions, namely: motor ganglia, accelerator ganglia, and inhibitory ganglia. The motor ganglia are supposed to be connected by an intermediate apparatus with the inhibitory ganglia on the one hand, and by a similar apparatus with the accelerator ganglia on the other; the former retarding or stopping, the latter accelerating or augmenting the muscular contractions presided over by the motor ganglia.

The researches of Gaskell appear to have placed the existence of at least two such ganglionic masses within the heart, beyond any possible doubt, and these are the inhibitory and accelerator or augmentor ganglia. Gaskell has shown conclusively that both accelerator and inhibitory nerve fibres go to the heart in cold-blooded animals, as well as in mammals. "The vasomotor (accelerator or augmentor) nerves of the heart," according to Gaskell, "originate in the spinal cord, passing from it in the rami viscerales of the second and third and lower thoracic nerves, as fine medullated nerve-fibres, upward into the ganglion stellatum. From the ganglion stellatum, they either pass directly to the heart or else reach that organ from the annulus of Vieussens and the inferior cervical ganglion."

"When examined in their passage from these ganglia, they are found to be, without exception, non-medullated. These cardiac fibres, then, pass into the ganglion stellatum (ganglion cardiacum basale of Gaskell and Gadow) as fine medullated nerve-fibres, and pass out of it as non-medullated fibres. Their stimulation produces acceleration and augmentation in the heart's action."

"The cardio-inhibitory nerves," according to the same author, "leave the central nervous system in the rami viscerales of the vagus and accessory nerves, retaining the same fine medullated nerve-structure until they reach the heart, where they enter into connection with the ventriculo-auricular ganglia or Bidder's ganglia, and cannot be traced further, the nerves proceeding from these ganglia being almost entirely composed of non-medullated fibres; their stimulation either retards or altogether stops the heart's action."

We have, therefore, not only physiological proof of the existence of

[1] Journal of Physiology, vol. vii., No. 1.

these two kinds of nervous structures, but Gaskell has also added histological proof, which never before had been made out so clearly as was done by him.

Both inhibitory and accelerator nerves being efferent nerves, it now remains for us to pass briefly in review what is known with regard to the afferent nerves of the heart.

The well-known depressor nerve of Ludwig and Thiry carries stimuli from the heart to the brain, and stimulation of its central end produces all the phenomena which ordinarily follow stimulation of inhibitory nerves; its connection with the vaso-inhibitory centre in the brain is, therefore, rendered more than probable. Fibres are also supposed to run within the vagus which cause reflex contraction of the vessels and rise of blood-pressure; these are called the "pressor fibres." According to Lauder Brunton, the depressor fibres of the vagus seem to act on the vasomotor system through the medulla itself, while the "pressor fibres" affect it through a centre in the brain, so that, when the brain is perfect, irritation of the central end of the vagus causes increased contraction of the vessels and increased blood-pressure; but, when the brain is removed, or its function abolished by opium, it causes dilatation of the vessels, and a decrease in the blood-pressure. Most all the sensory nerves of the body may, however, affect the heart reflexly.

Drugs or other stimuli, accordingly, may affect the heart's action in either one or all of the following ways, viz.: (1) *Reflexly*, or through irritation of some sensory nerve; (2) *indirectly*, or through irritation of certain centres in the brain; and (3) *directly* through their influence on the heart and its contained ganglia.

In experimenting with drugs on the isolated heart, we can, of course, only speak of their direct action on that organ, and to this our further discussion on the subject will be confined.

In studying the foregoing experiments, we find, in the first instance, that the enormous acceleration which follows the administration of certain doses of atropine, and which forms so conspicuous a symptom in the second stage of atropine poisoning, is absent. If, however, as Harnack believes, the very smallest doses of atropine are sufficient to paralyze the terminal filaments of the vagus, and that their paralysis is the cause of the great increase in the number of pulsations, then, it would seem that there is no reason why this occurrence should not take place in the isolated heart as well as in that of the intact animal. We find, on the contrary, that the smallest doses of atropine, in the mammalian heart, increase the number of contractions only from four to twenty beats per minute, and in that of cold-blooded animals about five beats.

From a careful examination of the results of our experiments in regard to this point, we have come to the conclusion that the smallest doses of atropine which in the intact animal give rise to a great increase in the

number of pulse-beats, do not only not paralyze the filaments of the vagus, but also are quite insufficient to stimulate them—in other words, leave these structures quite intact. By small doses of atropine the vasomotor apparatus alone is stimulated, and the vagus, though also capable of excitation in much less time even than the vasomotor nerves, requires a much stronger stimulus to excite it. It is well known that, when a stimulus is applied to both these nerve-structures which is sufficiently strong to excite them, the vagus nerves would be the first to respond, and the vasomotors last. This is exactly what takes place when atropized blood is allowed to circulate through the heart of sufficient strength to excite them both. Under these conditions we obtain, first, a decrease in the frequency of pulsations, and afterward the latter will approach the normal once more, or may even exceed that number. This is shown in almost every experiment which we have made. While, however, it takes a stronger stimulus to excite the vagus, the vasomotors, though slower in responding, are aroused by much weaker stimuli, and, therefore, capable of much greater excitation than the vagus by the same stimuli, and hence the probability is very strong in favor of the latter being inhibited to the extent that the vasomotors are over-stimulated.

So far, we have found no evidence in favor of the paralyzing action of atropine on the terminal filaments of the vagus, but, on the contrary, have every reason to believe that these structures are excited by this drug, and Rossbach and Fröhlich are, in our opinion, perfectly correct in believing that the primary slowing in the heart's action due to atropine is caused, in part, by the stimulating influence which the latter exerts on the terminal filaments of the vagus within the heart. This stage does not become apparent on small doses being used, and, for this reason, it may have been overlooked by some.

The second stage, or that stage in which there is more or less acceleration in the heart's action, is, therefore, due to vasomotor stimulation only; this will be the greater, the smaller the dose of atropine used. With doses even slightly larger than are sufficient to excite the vagus simultaneously with the vasomotors, there will be either no acceleration at all or the number of beats above the normal will be very small. This is well shown in those experiments in which extremely small doses of atropine were used, but in which their influence was extended over a long period and the effect of larger doses was, finally, attained. Here we invariably noticed an acceleration followed by a slowing in the pulse-rate. Therefore, according to our interpretation, even during the stage of acceleration the vagus filaments are not paralyzed, but, if at all affected, they must be excited, the stimulation of the vasomotor apparatus being capable of much more intense stimulation than the inhibitory, simply gains the mastery, though for a short period only. In the experiments which were made on cold-blooded animals with very small doses,

a condition of the heart was reached after a certain time which was almost identical with systolic arrest. The ventricle gradually became one-third its normal size, and the auricles diminished in about the same proportion, so that no blood entered the heart and none was consequently pumped around. This would be exactly what we should expect to find, if the stimulation of the vasomotor apparatus of the heart was unantagonized by inhibitory stimulation, and this condition may obtain in the case of atropine being used in very small doses, or when very weak atropized blood flows through the heart a certain length of time, which is insufficient to excite simultaneously the inhibitory apparatus. A further proof of the fact that atropine does not paralyze the vagus filaments, is found in those experiments in which very small doses of the drug having repeatedly produced an acceleration in the pulse-rate, large doses still produced the slowing which is characteristic of them. If the ganglia and filaments of the vagus had been paralyzed by small doses of atropine, it would not have been possible to excite them afterward with slightly larger doses. According to the strength of atropized blood which is allowed to flow through the heart, we may produce either acceleration or slowing; the former is invariably brought about by small doses, the latter by larger doses of the drug. The fact that either may be produced alternately several times during one experiment and on one animal, seems strong proof in favor of small doses of atropine not paralyzing the inhibitory nerves, and of larger doses stimulating instead of paralyzing the structures. The increase in the amount of work done during a certain stage of atropine-poisoning seems to be another proof in favor of this view of the subject. Vasomotor stimulation, pure and simple, causes the heart to beat more frequently, at the same time shortens the diastole and diminishes the carrying capacity of the ventricle, so that a decreased amount of work would be what we should expect to find under these conditions. We find, however, that the amount of work is increased during a certain stage of atropization; this stage is of short duration in the mammalian heart, but lasts much longer in the heart of cold-blooded animals. The immense amount of work which is done during this stage is due to the presence of inhibitory as well as vasomotor excitation, the former favoring the relaxation of the ventricle, hence increasing its capacity; the latter giving rise to increased frequency in the contractions; or in case the latter are decreased in number, as is the case when the inhibitory stimulation is about to gain the mastery, simply adds the extra amount of force required to pump around the abnormally large amount of blood, without increasing the number of the contractions. As soon, however, as the increased number of cardiac contractions gives way to a decrease, we also know that inhibitory excitation is beginning to gain the upper hand, and, unless the heart is quickly withdrawn from under the influence of atropine, diastolic arrest is certain to follow in a

short time. This is the condition which prevails during the so-called third stage of atropine poisoning. Our experiments show that the heart may recover perfectly from this condition, when atropized blood is withdrawn and pure blood is admitted, in time to prevent complete vasomotor exhaustion. The action of atropine being kept up, the heart is finally arrested in diastole as a consequence of vasomotor exhaustion from overstimulation and of inhibitory excitation. The muscular substance of the heart still responding to mechanical irritation even after diastolic arrest is complete, the order in which the different structures composing the heart are paralyzed is probably as follows: First, the vasomotor ganglia and their filaments. Second, the inhibitory ganglia and their filaments. Third, the muscular substance. Thus far, then, all the phenomena observed on the heart under the influence of atropia have been explained by the stimulating influence of the latter on the inhibitory and vasomotor nerve apparatus alone, and without the assumption of the inhibitory nerve apparatus being paralyzed at any time before diastolic arrest is produced. If, however, atropine stimulates the inhibitory nerve structures of the heart, it would seem that it ought also to stimulate these structures in organs other than the heart. The question now arises, What evidence have we of the stimulating influence of atropine on the inhibitory nerve elements supplying organs other than the heart?

When we take into consideration the large amount of work which the heart has to perform, and the powerful contractions which it has to execute constantly, it must become apparent, even without any other evidence to favor the view, that the vasomotor nerve-supply of this particular organ must be enormous when compared to that of other organs. This fact, therefore, must be kept in mind when we attempt to compare the effect of atropine on other similarly innervated organs to that which this drug exerts upon the heart. The pupil and the small intestine are examples of organs which are capable of contraction and relaxation. These organs, like the heart, are supplied with both motor and inhibitory nerve ganglia, but it is not at all likely that, quantitatively, their motor nerve supply is in any degree as great as that of the heart, and therefore the influence of atropine on the nervous structures of these organs cannot form so prominent a feature as it does in the case of the heart. This, of course, must also be true to a certain extent, at least, of the inhibitory nerves going to these organs. Smaller doses of atropine must, therefore, suffice to produce the characteristic effects of the drug than are required in the case of the heart. Nevertheless, in every other respect and if the interpretation of the nature of the action of atropia upon the automatic nerve ganglia of the heart, which is here given, be correct, and it is further to be presumed that the same stimuli must naturally affect allied organs, the histological structure and physiological function of which is similar, alike, or nearly so, then the evidence

ought not to be wanting which favors the similarity or identity of the action of atropine on these organs with that which the latter drug has upon the heart.

With regard to the pupil, Gaskell says:

"It is a striking and highly suggestive fact that the anatomical course and the histological characters of the nerves which dilate the pupil, are precisely similar to the inhibitory nerves of the circular muscles of the intestines, etc., which run in the abdominal splanchnics. In both cases they leave the central nervous system in the thoracic outflow of visceral nerves, the one passing out in those upper rami viscerales directed upward to form the cervical splanchnics; the other in those lower rami viscerales which pass downward to form the abdominal splanchnics. In both cases they leave the central nervous system among the fine medullated fibres of the anterior roots, the special anterior roots which contain the dilator fibres of the pupil being, according to Budge, the second, third, and fourth thoracic—according to my own observations in the dog, more especially the second thoracic; in the frog they pass out in the anterior root of the fourth nerve.

"In both cases they pass over the lateral ganglion (main sympathetic chain) along the corresponding splanchnic nerves to the distal ganglia before they alter their histological characters; the one passing directly to the superior cervical ganglion in the bundle of fine medullated fibres which can be dissected out of the conjoint vago-sympathetic in the neck, the other in the bundle of similar fibres which passes along the abdominal splanchnics into the semilunar ganglia. In both cases, they cannot be traced further as medullated fibres. In the one case they, in all probability, lose their medulla in the distal semilunar ganglion; in the other, with equal probability, in the distal superior cervical ganglion.

"The histological, anatomical, and physiological evidence, all point to the conclusion that in the sphincter muscle of the iris we have yet another example of a muscular stucture supplied by two nerves of opposite character, the one motor, the other inhibitory."

In this manner Gaskell has furthermore shown that the muscular tissues of the visceral and vascular systems are supplied by two sets of nerves, of which the one sets these tissues in activity and causes their contraction; the other inhibits their contractions, and causes their relaxation. The accelerator nerves of the heart, according to Gaskell, belong structurally, as well as anatomically, to the group of vasomotor nerves, and the nerves which retard or stop the heart's action, to the class of inhibitory nerves.

The question, therefore, arises, What analogy do we find in the action of atropine and its congeners, on the heart, and that which these drugs have on other similarly innervated organs? Let us first examine their action on the pupil.

1. *The Pupil.* It is a well-known fact that all the members of the atropine group cause dilatation of the pupil. Dilatation of the pupil, however, according to the latest researches, is brought about by a stimulation of the inhibitory nerves supplying it, paralysis of these nerves being followed by contraction of the pupil. We have, therefore, here an example of atropine stimulating inhibitory nerve-structures as it does in the heart, the analogy appearing to be quite complete. Atropine, how-

ever, is also known to be a vasomotor stimulant when used in very small doses, and stimulation of the vasomotor nerves supplying the pupil would cause its contraction. It is well known that, under conditions hitherto not yet fully determined, atropine sometimes causes transient but slight contraction of the pupil before dilatation comes on. This would be due, according to our interpretation, to too small doses of atropine, and as soon as a sufficient amount of atropine is absorbed, dilatation must supervene; for the vasomotor nerve apparatus, though quickly and intensely stimulated, is rapidly exhausted by too large doses; the inhibitory nerve apparatus, on the other hand, requiring larger doses to set it into full activity. We have here, as in the case of the heart, simply to regulate the dose according to the effect we wish to produce. If the smaller doses of atropine were sufficient to paralyze the inhibitory nerve-apparatus, then contraction of the pupil would have to follow invariably, and the application of larger doses would not change anything in this result. The facts, however, are quite different, as is well known. In the pupil, therefore, we have a very perfect example illustrating the action of atropine on the two kinds of nerve-structures, exactly as this was made out in the case of the heart.

2. *The Intestine.* The best text-books state that atropine, in very small doses, increases the peristaltic movements of the intestine; moderate doses completely arrest these movements, but do not destroy the irritability of the muscular fibres; large doses stop the movements, and also paralyze the involuntary muscular fibres so that they contract either very feebly, or not at all, on direct irritation. In the case of the intestine, we have yet another example of small doses of atropine stimulating vasomotor nerves, and of larger doses stimulating inhibitory nerves.

3. *The Bloodvessels.* In experiments with atropine on the bloodvessels, published by me in this journal for July, 1885, it was clearly shown that atropine causes at first contraction, and then dilatation of these vessels. We have, therefore, here, as elsewhere, evidence of vasomotor stimulation preceding inhibitory stimulation when small doses are used. In the experiment referred to, it was, however, also shown that this initial contraction took place only during the first, and, at most, the second observations, but not the subsequent ones, apparently indicating that the vasomotor nerves lost their excitability long before the inhibitory nerves did.

The evidence in favor of the uniformity of the action of atropine on these different organs might be still further increased, but the examples cited above are deemed quite sufficient to prove our point. Atropine has long been a favorite remedy of clinicians in all painful spasms of involuntary muscles, such as lead colic, simple colic, asthma, the spasms set up by renal and biliary calculi, painful spasmodic contraction of the circular muscular fibres of the neck of the womb in parturition, etc. Clinical evidence, therefore, is not lacking in proof of the fact that atro-

pine and its allies cause the relaxation of involuntary muscular fibres, by their stimulating influence on inhibitory nerves and their ganglia.

From this brief consideration of the more prominent facts brought out by these experiments, the conclusions are as follows, viz.:

1. Atropine, homatropine, hyoscine, hyoscyamine, and daturine are stimulants of the sympathetic nerve apparatus of the heart.

2. The vasomotor portion of this nerve apparatus is affected by comparatively small doses of these drugs, giving rise to either acceleration or augmentation in the heart's action.

3. The inhibitory portion is excited by larger doses only, giving rise to slowing of the heart's action, and, finally, causing diastolic arrest.

4. The muscular substance of the heart is greatly excited by atropine, homatropine, and daturine, and only slightly so by hyoscine and hyoscyamine.

5. The vasomotor nerves and their ganglia are the first to become exhausted, the inhibitory nerves and their ganglia are the next, and the muscular substance is exhausted last of all.

6. The slowing of the heart's action which follows the administration of these drugs in the intact animal, may be sufficiently accounted for by their influence on the inhibitory nerves and ganglia of the heart itself.

7. The acceleration following the administration of certain doses of these drugs cannot be sufficiently accounted for by their action on the accelerator nerves and ganglia within the heart, but is principally due to causes resident outside this organ.

In conclusion, I have to acknowledge my indebtedness to Professor H. Newell Martin for kindly placing at my disposal the well-equipped laboratory under his charge at the Johns Hopkins University, Baltimore, where the experiments on the heart of the dog were made. I also take this opportunity to thank Dr. John C. Hemmeter for valuable assistance rendered me during some of the preliminary work on the dog's heart. The experiments on the heart of the frog and terrapin were performed at the laboratory of the Museum of Hygiene, under the auspices of the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

TYPHOMALARIAL FEVER.

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The early use of any new medical term is necessarily somewhat indefinite, especially when those responsible for the name have not at first clearly indicated the condition which it is intended to signify. In America the term typhomalarial fever is widely used, if we may judge

from the number of communications on the subject to the medical journals and societies in all parts of the United States and Canada. To the majority of English practitioners, whose experience has been limited to their own country, the name is unfamiliar, and to all it is wanting in accurate definition. Now that we have admitted the term into our nosology, under official sanction, it is well that we should endeavor clearly to understand to what class of cases it should apply. Although it has been used for a quarter of a century, the term typhomalarial fever is not yet so well defined as to bear a universal significance. The London College of Physicians, in its nomenclature of disease, defines it as a *combination of malarial and enteric fevers.*[1] The Section of Medicine at the International Medical Congress held in Philadelphia in 1876, expressed the opinion[2] that "typhomalarial fever is not a special or distinct type of disease, but the term may be conveniently applied to the compound forms of fever which result from the *combined influence of the causes of the malarial fevers and of typhoid fever.*"

A similar though somewhat different view is well stated by Dr. E. G. Russell in a paper on malarial fevers read before the Epidemiological Society of London in 1881.[3] He says:

"When a distinctly malarial complication accompanies and is bound up with true enteric fever, we have the disease that has been recognized, and described by numerous writers of divers periods and lands, as paludo-enteric or typhomalarial fever."

If any distinguishing term is required for such cases, which undoubtedly exist, I should prefer the term "malarial enteric fever" which I proposed in my paper on "Fever at Suakim."[4] The most correct description would be to put down both diseases, enteric fever and malaria, just as one would enter syphilis and scarlet fever if the two coexisted. But again, Dr. Russell says:

"Typhomalarial fever may be taken as affording an illustration of the parallelogram of forces; the malarial poison and the typhoid poison being the two forces acting on a point—the patient—and being represented in magnitude and direction by the two sides of the parallelogram, each produces its full effect in its own proper direction; the resultant being represented in magnitude and direction by the diagonal through this point—*i. e.*, by typhomalarial fever."[5]

Other observers consider typhomalaria to be, not the resultant between two causes, but describe it as enteric fever *modified* or even *induced*, by *malaria*. The chief exponents of this view are Sir Joseph Fayrer and M. Léon Colin. The former writes:

"I believe that in India enteric lesions are apt to come on in the course of miasmatic fever, and that in this condition they not only resemble but *become*

[1] The Nomenclature of Disease. Second edition. London, 1885.
[2] Transactions Int. Med. Congress, Philadelphia, 1876, p. xxxviii.
[3] Transactions Epidemiological Society, vol. iv., part iv., p. 559.
[4] Transactions Med.-Chir. Society, 1885–86, vol. lxix. p. 247.
[5] Transactions Epidemiological Society, vol. iv., part iv , p. 559.

identical with those of specific enteric fever, which is caused in India as in England."[1] Or again, "I am, and have long been of opinion that a form of fever exactly like European typhoid, except in its etiology, exists in India and other hot and malarious countries, and that it is due to climatic causes, not to filth or specific causes such as give rise to it in England."[2]

M. Léon Colin[3] also holds that these fevers result from a transformation of paludal into typhoid fever; or, in other words, of malarial into enteric fever. Barker[4] speaks of typhoid fever being produced by "malaria," but he uses the latter term in the wide sense of "infected air," not paludal miasmata only. Inspector General Maclean, Professor of Military Medicine at Netley, in his report on the enteric fever cases sent to Netley from Egypt in 1882, says:

"Medical officers, who, like the writer, have studied the disease in India, recognize two types; the first, seen in young soldiers who have been but a short time in the country, is, in all its main features, undistinguishable from enteric fever as seen in Europe. In the other, observed in the persons of those longer resident in India, a *malarial complication*, the outcome of that poison, and the changes wrought by it in the solids and fluids of the body, give a distinctly remittent character to the disease, and the lesions in fatal cases, revealed post-mortem, point unequivocally to the work of two factors, the enteric plus the malarial poison."[5]

Surgeon-Major R. W. Jackson, in writing on enteric fever and its modification by malaria in Southeastern Africa, dissents from the hybrid view of the disease. He writes:

"From what I have seen of the disease termed typhomalaria, I am inclined to believe that the two elements do not intimately mingle in the course of the disease; the malarial appears to be more or less *parasitical* in many cases, with a decided tendency to seize on a subject debilitated by any cause."[6]

Fleet Surgeon Norbury, C.B.R.N.,[7] says, "The so-called typhomalarial fever is, in my opinion, simply enteric fever, and nothing else;" though, as he says, the symptoms may be modified by malaria. These both describe what I would term "malarial fever."

The view to which I myself incline is also propounded and upheld by others whose observation of the disease is more extended than my own; sometimes set forth in published opinions, sometimes borne out by reports of cases or pathological examinations. According to this view, typhomalarial fever is not a subdivision of enteric fever, but a form of malarial fever. This opinion was held by the Commission formed for the purpose of a special inquiry into the disease during the War of the Rebel-

[1] Climate and Fevers of India: Croonian Lectures, 1882, p. 227.

[2] Trans. Epid. Soc., vol. iv., part iii., p. 269.

[3] De la Fièvre Typhoide Palustre: Archives Générales, 1878, part 1, p. 276.

[4] On Malaria and Miasmata: The Fothergillian Prize Essay for 1859. By T. H. Barker, London, 1863, p. iii.

[5] Army Medical Reports, vol. xxiii., 1881.

[6] Dublin Journal of Medical Sciences, January, 1881, p. 17.

[7] Medical and Surgical Notes on South African Warfare. Transactions International Medical Congress, London, 1881, vol. ii. p. 513.

lion, who reported that the camp fever then so prevalent was "bilious remittent fever, which, not having been controlled in the primary stage, had assumed that adynamic type which is present in enteric fever."[1]

This I should be inclined to adopt as my definition of typhomalarial fever, merely substituting "malarial" for "bilious remittent," and not venturing to specify any cause for the assumption of the typhoid symptoms. My definition would then run as follows: *Typhomalarial fever is a malarial fever which has assumed that adynamic type which is present in enteric fever.* Several of our army medical officers appear to favor this view.

There still remain those, like Virchow,[2] Welch,[3] and others, who would cut the Gordian knot by agreeing with Brig.-Surgeon J. A. Marston, that "there seems to be no satisfactory evidence for including a typho-malarial fever as a distinct morbid entity in our nosology."[4] I agree with these in so far as they hold that typho-malaria is not a specific disease or distinct morbid entity; but I hold that there is sufficient justification for retaining the term in our nosology, provided we understand clearly what we intend should be its signification.

Considering, then, typho-malarial fever as a manifestation of the malarial poison, in which continued fever is accompanied by intestinal symptoms—mainly diarrhœa—and which tends to assume an adynamic or typhoid condition, I proceed to give a sketch of the disease, tracing shortly its history, or rather a history of its recognition, and then describing its symptoms and pathology. Finally, I will endeavor to give its points of difference from enteric fever, so as to help us to arrive at a diagnosis in doubtful cases.

History.—Where history reaches back to the first record of war we have mention of disease breaking out in the camps; and the attendance of disease on armies in the field has recurred with fearful regularity in all campaigns. As records became more exact (or the preservation of them more successful), descriptions of the prevailing camp-fevers have come down to us with the history of the wars. And looking through those military medical annals, we find that the ancients had to fight against the same disease as we do now, in the field and in the camp, in addition to the "filth diseases" which we now in a great measure prevent. To say that the fever of which I am speaking existed long before it was described so as to be recognizable by us, and was described long before it was named, is only repeating a truism which will hold for almost every disease. In the wars of the middle ages, armies in Italy, Hungary, and along the shores of the Danube suffered terribly from fevers,

[1] Woodward: Transactions International Medical Congress, Philadelphia, 1876, p. 312.
[2] Kriegstyphus und Ruhr., Virchow's Archiv, Bd. lii. (1871), 1–42.
[3] "Enteric Fever." Alexander Prize Essay, 1883.
[4] Army Medical Reports, 1880, vol. xxii. p. 326.

chiefly typhus and enteric, among which cases occurred very nearly resembling what we now call typhomalarial. To come nearer to our own times, in 1760 Göttingen was visited by an epidemic, described by Röderer and Wagler[1] as *morbus mucosus*, which was a continued fever with diarrhœa and typhoid symptoms, and with pathological signs of intestinal catarrh. Then we have the records of the terrible Walcheren fever in 1809, which spread so rapidly among the British troops that in a month after landing there were only 23,000 infantry and 2000 cavalry fit to take the field, out of a force of nearly 40,000 men: the number in hospital was then nearly 3000, increased in another fortnight to 7000, and in ten days more to nearly 11,000.[2] This was recognized at the time as a malarial fever, and the symptoms as described by Davis and others in many cases resemble typhoid. Similar fevers are described by Pringle,[3] as occurring in our troops in the low countries half a century earlier.

After the close of the Peninsular War there was no very protracted campaign in malarious countries until the great civil war in America (1862) fifty years later. During this struggle, which lasted four years, large bodies of men were encamped in low-lying districts in the valleys of the Mississippi, the Ohio, the Potomac, and the Chickahominy rivers, where malaria abounds. A complete and well organized medical service made it possible to collect reports from the various divisions of the army and afterward to compile a medical history of the war, which is a storehouse of information for all who wish to study the diseases incidental to campaigning, or to perfect the hygiene of armies. It is, therefore, to the history of the American war that we are indebted for a clearer description of the disease of which I am speaking, and it was during this war also that the term typhomalarial fever was first used. Many of the surgeons who had known enteric fever at home, found that the prevailing camp fever, though resembling typhoid—often so closely that they had no hesitation in diagnosticating it – had yet in many cases differences so marked as to call for special reports. A commission was appointed to investigate the matter, and on the drawing up of statistical forms for returns of diseases in the army, Dr. Woodward, then Assistant Surgeon in the United States Army, proposed the term typhomalarial fever—the disease being considered by him to be a hybrid between enteric and malarial fever. The first official recognition of the term is in the United States Army Statistical Returns for 1862.

But the disease is not confined to armies in the field, and had been recognized before this time. Lancisci,[4] had noticed it in the Roman

[1] De morbo mucoso. Göttingen, 1762.
[2] Davis: On Walcheren Fever, 1810. Introduction.
[3] Observations on the Diseases of the Army, 1774.
[4] De Noxiis Paludum Effluviis. Geneva, 1718.

marshes in the 17th century, and in America Drake[1] had described it and called it "remitto typhus" twelve years before Woodward named it. English observers in India and elsewhere had described many cases of it as malarial fevers or bilious remittent; and the French had seen it in Algeria. In late years our Army Medical Reports contain many descriptions of the disease and opinions as to its nature.

Synonyms.—The disease under consideration is described under many names; and various terms are used by different writers as synonymous with typhomalarial fever. I have mentioned Drake's remitto-typhus, or secondary typhus fever, as he also calls it. Then we meet with paludal-typhoid, paludo-enteric, miasmatic typhoid fever, fæco-malarial fever, bilious remittent, gastric remittent, adynamic remittent, typhoid remittent, and autumnal fever, all of which are now in use; and mucous or pituitous fever (Copeland), *typhus intermittens subintrans and febris intermittens typhosa* (Hermann Schmidt), which are obsolete. From a most valuable report[2] by Surg.-Major Veale on the Fevers from the Mediterranean, treated at Netley in 1879, I get the following: Malta fever, rock (or Gibraltar) fever, Mediterranean fever, and his own suggestion, viz., complex, or complicated fever (*febris complicata*). Many cases are also included under the comprehensive term "simple continued fever."

In giving the synonyms, I only mention terms used when the observer seems to have recognized the disease as that we are calling typhomalarial fever. The other names under which cases have been returned would seem, according to Dr. Veale, to range from enteric fever and rheumatism, to phthisis or chronic pneumonia.

Etiology.—If I say that wherever malaria is found, there typhomalaria may also occur, I need go no further in describing the climatic and telluric conditions which favor its development, for that would carry me far beyond the scope of this paper. It has been described as occurring in all four continents, and with a wide distribution in each. It is not confined to tropical or subtropical countries, though perhaps more frequent in such climates: it is not uncommon on the shores of the Mediterranean,[3] and cases of typhomalaria have been described (by Dr. Handfield Jones[4] and others) as occurring in England. Until recently, no other fevers were recognized in the Romney marshes except those due to malaria.[5]

In the tropics it would seem that the season at which it is most prevalent is the setting in of the rains (Fayrer and Don), and in more

[1] The Principal Diseases of the Interior Valley of North America. Cincinnati, 1850.

[2] A. M. D. Reports, 1879, vol. xxi. p. 271.

[3] I believe, as was remarked at the time (Lancet, 1886, vol. i. p. 867), that it is to this cause that we must attribute the loss of a distinguished member of our profession last year, I mean Mr. Cooper Foster.

[4] Medical Times and Gazette, June 27, 1885.

[5] Hilton Fagge: Practice of Medicine, vol. i. p. 283.

temperate climates, as would naturally be expected, it occurs at the season when both malarial and enteric fevers are most prevalent, viz., in the autumn. With regard to individual predisposition, youth, fresh arrival in a malarious district, and any cause that tends to debilitate the individual, or to depress the spirits, seem to lay persons open to an attack. Over-crowding, or the collection of a large number of persons together, sanitary defects, foul smells, bad water, bad food, hard or harassing duties, are all mentioned by different writers. Thus, campaigning in a malarious country brings all the predisposing causes into force. Standing camps, or prolonged occupation of camping grounds where filth, decomposition, and malarial emanations exist in a subtropical or tropical heat, are most favorable to its development.[1] Some writers suggest that the presence of enteric fever is a predisposing cause; perhaps, rather, it is a cause for the prominence of intestinal symptoms. Certainly the two diseases frequently occur side by side, as is clearly seen in the reports of the American war, in those of our Zulu war, and also at Suakim last year. M. Boudin,[2] the French military surgeon, considered, from his experience, that malaria "excludes, and is antagonistic to" enteric fever, but I suppose he would find few supporters at the present day. The poison being essentially that which produces intermittents and remittents, the mode of their introduction into the system is probably identical.

Typhomalaria is not transmissible from person to person (Harley),[3] and in this differs from enteric fever.

Having gained a hold upon the individual the poison may lie dormant for a considerable time, and this appears to be one of the marked characteristics of malarial diseases. This was observed in many cases among our troops after the Egyptian campaign in 1882, and also after the Soudan expedition of 1885; on both of which occasions men were constantly admitted to hospital for fever resembling closely enteric (and often correctly so diagnosticated) for some weeks, or even months, after arrival in England; and both among the troops at Aldershot and in Cyprus in 1882,[4] and in the brigade of Guards in 1885, the cases, almost without exception, occurred among those who had returned from the seat of war. In 1882 it is recorded that the brigade of Guards left Alexandria at the end of October and beginning of November (from October 30th to November 7th), and cases of fever continued to be admitted to hospital for nearly nine weeks after that date; and the remark, "that the disease was of Egyptian origin, and was not due to infection from one to another in this country," seems highly probable, because the spread of it was confined to those who had been in Egypt.[5]

[1] Norbury, Trans. Int. Med Congress, London, 1881, vol. ii. p. 513.

[2] Traité des Fièvres Intermittentes, remittentes et continues de pays chaudes et des contrées marécageuses. Paris, 1842.

[3] Reynolds's System of Medicine. Art. Enteric Fever. 1st ed., 1886, vol. i. p. 610.

[4] A. M. D. Reports, vol. xxiv., 1882.

[5] A. M. D. Reports, 1882, vol. xxiv. p. 117.

SYMPTOMS.—The onset is often gradual, sometimes sudden, and the cases may at first show no differences from other results of malarial poisoning.

Certain premonitory symptoms are mentioned by various observers, among which tonsillitis is spoken of by more than one. Sir Anthony Home, speaking of an outbreak of fever at Sitapur, in Bengal, says, "Nothing is more frequent than the connection in point of time between a preceding tonsillitis and a following enteric fever illness."[1] I suspect that typhomalaria would be a better term to describe this outbreak, and I am unable to find any mention of a preceding tonsillitis in the articles on enteric fever in any of the various text-books. Surgeon-General Woolfreyes, in describing the fever which occurred among the troops in Natal during the Zulu war, and which he recognized as typhomalarial, says, "It, as a rule, commences with sore throat, a peculiarity."[2] So, too, the fever designated generally as "typhomalarial," so prevalent at the several outposts during the Galeaka-Gaika campaign in the Cape Colony, nearly always commenced with sore throat.[3] Dr. Don speaks of tonsillitis preceding the continuous enteric fever of Bermuda.[4] I noticed several cases of tonsillitis among the troops at Suakim while fever was prevalent, but was not then aware of their possible significance. I certainly met with it in some men who were never admitted to hospital then or later.[5] The onset then is gradual, with indefinite malaise, headache, loss of appetite, and possibly chills, and pains or aches in various parts of the body. Assistant Surgeon Billings, U. S. Army, says, "The malarial element is always prominent at the commencement, the typhoid element making its appearance on the fifth or sixth day, and gradually becoming more prominent."[6] Sickness is a distinctive and almost constant symptom, the vomited matters often being greenish.

Diarrhœa is generally present, but where camp-diarrhœa is prevalent may cause no comment.

As the disease progresses the diarrhœa may be more frequent. The stools vary: they may be greenish, as is common in remittents; watery and brown; or sometimes resembling the "pea soup" stools of enteric fever.

Now and then, when diarrhœa is the rule, a solid and apparently healthy motion may be passed in the middle of the illness. There may be constipation throughout.

[1] A. M. D. Reports, 1882, vol. xxiv. p. 81.

[2] Fayrer: Op. cit., p. 194.

[3] A. M. D. Reports, 1879, vol. xxi., p. 294.

[4] Ibid., vol. xi., 1869. Appendix. No. xi. p. 385.

[5] I may mention that since my return from Suakim I have had several attacks of "Soudan Fever," —clearly malarial; and that on the last few occasions I have noticed that sore throat precedes and accompanies the fever.

[6] Report on the Treatment in the Army of the Potomac during 1864.

The temperature is raised from the commencement of illness; at first, it may be, with complete remissions, afterward becoming continued, sometimes very high, and often irregular. The pulse is small, feeble, often dicrotic, and rapid, and shows no relation to the temperature.

A symptom is noticed in the reports of the Zulu war which reminds us forcibly of the description of the mucous fever in Göttingen. This is a "hyperæmic condition of the entire alimentary tract, indicated by congestion of the throat and fauces, the excessive secretion of mucus, the copious mucous diarrhœa, accompanied by tenesmus, and followed after straining by a little pure blood."[1]

Jaundice has been noticed in several instances, and hepatic congestion is frequently met with in the early stages. The abdomen is distended; and there may be pain and gurgling on pressure in the right iliac fossa, a frequent sign in diarrhœa. The spleen is enlarged. The tongue in severe cases is furred and swollen; later it may become dry, brown, and cracked.

In severe and prolonged cases we find subsultus tendinum, sordes on the teeth, low muttering delirium, and continual vomiting. Death results from exhaustion. It is stated that rose spots are found on the abdomen as in enteric fever, but I should almost consider the spots to be pathognomonic of the specific disease.

In cases which end in recovery, the duration of the disease is very variable. During an epidemic many men come into hospital with all the signs of a severe attack, and after a few days' illness are practically well, though careful observation might show evening fever for some time after they have left the hospital. Severe cases have a longer course than enteric fever, and linger on for seventy days or more (Maclean, Lane, Notter). In one of my cases the patient was under treatment for thirteen weeks, or ninety days. For some time after all marked illness has disappeared the temperature may go on oscillating from 98° to 102° or 103° F. at night, the patient meanwhile having a good appetite and feeling well.[2] This prolonged course is very characteristic, and quite different from the relapses in enteric fever; sometimes diarrhœa continues during the whole time. In some cases a rheumatic affection of the fibrous tissues round the joints and other parts[3] may persist for weeks or months; in others, anæmia is the only remaining sign of illness. Tenderness over the hepatic region may be noticed throughout convalescence.

Complications.—Of these the chief are pulmonary congestion, bronchitis or pneumonia, hemorrhages from the bowels, or other mucous surfaces, as epistaxis. With these hemorrhages I may mention the purpuric

[1] A. M. D. Reports, 1879, vol. xxi. p. 293.
[2] Ibid., p. 206.
[3] Ibid., p. 266.

blotches on the skin noticed in two of my fatal cases at Suakim, and reported in my paper on the fever there.[1]

Purpura has been noticed as a complication of Gibraltar fever,[2] which sometimes at least takes the typhomalarial form. In the Zulu war, also, we are told that in some of the cases of fever there was "a cutaneous redness larger than a man's hand, which appeared in various localities, but especially on the side of the thorax, and outer side of the upper arm." This did not disappear on pressure, and on incision post mortem small blood coagula were found in the centre. It was always a fatal sign.[3] Profuse perspiration with sudamina may occur. Rheumatism, sometimes attended with effusion into joints, has been observed,[4] and has long been recognized as a usual sequela of Malta fever or Mediterranean remittent.[5]

Pathology.—A clear understanding of the pathological changes brought about by any morbid process is essential, if we wish to perfect our knowledge as to the symptoms, course, or general history of a disease. For it is by pathological examination that we are enabled to check or verify our diagnosis, and so know positively with what disease we have to deal—a point which may remain uncertain without such means of proof. I am about to venture a statement which will meet with some opposition, if I may judge by the opinions expressed by most of those who have written on typhomalarial fever—it is this. The pathological changes found after death from typhomalaria differ from those characteristic of enteric fever, and serve to distinguish the two diseases from one another: they are, in fact, the *pathological signs of malarial fevers*. Many writers state that necropsies in cases of typhomalarial fever show the peculiar ulceration of Peyer's patches which is considered characteristic of enteric fever. I believe that when the characteristic Peyerian ulceration is found we may take it that the patient has had true enteric fever, which may have been complicated with malaria no doubt, but this does not constitute typhomalarial fever.

The two diseases, as I have already mentioned, often exist side by side in the same camp, and may be treated in the same ward; the symptoms during life are much alike, and doubt may exist as to the diagnosis throughout the whole illness. What wonder then if a case diagnosticated as typhomalarial fever convict us of error in diagnosis by revealing Peyerian ulceration at the post mortem, or if a careful search in a case supposed to be enteric fever should disappoint us by the absence of enteric ulcers. A most instructive account of a simultaneous outbreak of enteric fever and of typhomalarial fever in two regiments in adjoining

[1] Trans. Med.-Chir. Society, 1885–86, vol. lxix. p. 247.
[2] A. M. D. Reports, 1881, vol. xxii. p. 33.
[3] Trans. Int. Med. Congress, London, 1881, vol. ii. p. 513.
[4] A. M. D. Reports, 1879, vol. xxi. p. 266.
[5] Ibid., 1861, vol. iii. p. 507.

camps, where the two diseases could be studied side by side, will be found in the Appendix to the *Army Medical Report* for 1879. This report teems with important facts which help us to study the differences between the two diseases. In this outbreak it was at first considered that the two fevers might be one and the same disease, till fatal cases demonstrated that the two diseases were perfectly distinct: for, whereas, the necropsies in one camp showed "the local lesions of the intestinal glands which are the invariable concomitants and anatomical expression" of enteric fever, in a fatal case in the other camp the intestine was found to be perfectly healthy.[1] I do not wish to be understood to deny that ulcers may be found in the small intestine in typhomalaria: on the contrary, I imagine they may be frequently present, but they do not select Peyer's patches or the solitary glands, or confine themselves to these, as enteric fever ulcers do. The presence of ulcers in the small intestine in patients dying of malarial fevers has been observed over and over again. Annesley[2] and Twyning[3] both mention superficial ulceration of the mucous membrane of the small intestine in protracted cases of the "congestive fever" of the cold season in India. Ulcers, sometimes possibly those of enteric fever, but sometimes quite different, were noticed in the Walcheren fever (Davis). Dr. Wall, of Calcutta, describes irregular ulceration, by no means selecting the site of Peyer's patches, and often encircling the intestine.[4] Surgeon-Major Edge, in reporting on the camp fevers during the Zulu war, writes: "Post-mortem examination revealed the great differences between the diseases. In remittent fevers the ulceration was not in Peyer's patches or certainly not confined to them, nor were Peyer's patches or the solitary glands traceable in the great inflammation and thickening of the lower part of the ilium."[5] Others are unable to distinguish between the ulcers in some malarial fevers and those of enteric fever, believing the former to develop into true enteric. Dr. Morehead goes further and says, "Disease of Peyer's glands . . . is not peculiar to typhoid fever only, for it occurs in cholera, in protracted diarrhœa, and in acute muco-enteritis, or as an occasional complication of remittent fever, and is a frequent one of phthisis pulmonalis."[6]

Dr. Jules Guérin,[7] of Paris, considers that the organic lesions found in the intestine in enteric fever are the effects of virulent and ulcerative action of typhoid matters on the parts—*i. e.*, a local irritative action, not the result of the specific poison. If this were so, other irritative contents of the bowels might be expected to produce exactly the same results.

[1] A. M. D. Reports, 1879, vol. xxi. p. 253.
[2] Diseases of India.
[3] Diseases of Bengal, second edition, 1835.
[4] Fayrer, op. cit., p. 175.
[5] A. M. D. Reports, 1879, vol. xxi. p. 306.
[6] Researches on Diseases in India, p. 160.
[7] Transactions of the International Medical Congress, London, 1881, vol. ii. p. 91.

To enumerate the chief pathological appearances found in cases of typhomalarial fever: First, as to the alimentary tract. There may be congestion of the throat and pharynx, with excessive amount of secretion; and this may extend throughout the whole length of the alimentary canal. This was found in one of my necropsies at Suakim, where, besides the injection of the mucous coat, submucous ecchymoses were present. Woodward notices this condition. He has collected a number of autopsies in which the illness had strikingly resembled enteric fever, but in which dissection showed no other lesion in the alimentary canal than a smart intestinal catarrh. The characteristic lesions were "Patches of inflammation scattered irregularly throughout both small and large intestines and enlargement of the closed glands, often associated with pigment deposits."[1] Annesley says, "occasionally the mucous surface (of the intestines) is of a brick-red or purplish shade of color, apparently ecchymosed."[2] Twyning also mentions[3] inflammation and ecchymosis of the small intestine without ulceration; and morbid vascularity of the duodenum. In cases of the Walcheren fever, Davis found the intestines of a purplish hue. Surgeon-Major Boulton mentions having seen this in the West Indies.[4] Congestion and ecchymosis in the intestines must, therefore, be considered a frequent pathological sign in typhomalaria; and would appear to be not uncommon in remittent fever. Most observers consider the congestion of the mucous coat to be most marked in the duodenum, and upper part of the jejunum; and some describe the ilium as healthy. I have certainly seen the latter congested and ecchymosed.

In more severe or prolonged cases ulcerations may be found in almost any part of the small or large intestine, though Annesley thinks it is most commonly to be seen in the termination of the ilium; probably here he is confounding it with enteric. They are irregular ulcers, which may be small and agglomerated, or large and far apart, sometimes encircling the intestine, and not selecting the intestinal ductless glands. They are usually superficial, not penetrating beyond the mucous membrane, though they may be deep enough to cause perforation.[5]

The spleen is enlarged, soft, and friable; the liver congested and hard; the gall-bladder sometimes distended with bile. All the above, be it observed, are pathological results of malaria, not of enteric fever poison.

The lungs may show signs of the complications which affect those organs, most commonly being congested at their bases posteriorly.

Purpuric ecchymoses may be seen in the skin.

[1] Typhomalarial Fever. Transactions of the International Medical Congress, Phila., 1876, p. 331.
[2] Op. cit., vol. ii. p. 457.
[3] Op. cit.
[4] A. M. D. Reports, 1879, vol. xxi p. 306.
[5] Op. cit.

DIAGNOSIS.—All those who have seen much of malaria have noted how its symptoms frequently simulate those of enteric fever, so closely, in some cases, that a diagnosis is almost impossible. This led Dr. J. Harley[1] to express the opinion that "we unhesitatingly conclude that enteric fever is often a part of intermittent fever, and the converse." The Indian records before the time of Scriven—and even since enteric fever has been recognized in India—show this difficulty clearly. Malaria may cause a continued fever with diarrhœa and intense prostration; and enteric fever, as Murchison pointed out, may show remissions in its temperature chart, or put on the intermittent type at the commencement in malarious countries.[2] When, therefore, we come to deal with a disease intermediate as regards its symptoms between remittents and enteric fever, the difficulty of diagnosis is increased, especially when all three diseases exist side by side. An example of this difficulty occurred on board H. M. S. Alexandra, on the Mediterranean Station in 1879, where there was a case, the diagnosis of which was attended with uncertainty till after its fatal termination, when the post-mortem examination "revealed such enteric disease as could only be attributed to the typhoid poison, viz., ulceration of the solitary glands and of Peyer's patches with perforation of the bowel; yet the symptoms of this case during life differed very slightly from those of others in which these pathological changes were entirely wanting."[3] I shall not attempt to give any points to distinguish typhomalarial fever from malarial fevers (as those who consider it a subdivision of enteric fever would be obliged to do), for I consider it a malarial fever, to which a special interest attaches, from its symptoms simulating enteric fever, though its etiology and pathological result are different.

The real question is, How are we to distinguish it from enteric fever? and that is the main difficulty. We must not forget that enteric fever can be modified by malarial complications—what I propose to call "malarial enteric fever"—and that this increases our difficulty in discriminating between them. The chief modifications in the course of enteric fever produced by malaria are as follows: A prolongation of the incubation period (as was seen after the Egyptian and Soudan campaigns—for in some of the fatal cases among those referred to on page 401, the Peyerian ulcers of enteric fever were found); variations in the temperature curves, such as a wider daily range, marked intermissions or regular remissions, and a lengthening of the febrile condition, or more protracted convalescence. Typical ague attacks have occurred in the course of enteric fever.[4]

[1] Reynolds's System of Medicine, 1866, vol. i. p. 604.
[2] Bartlett: Fevers of the United States, 1856.
[3] Naval Medical Report, 1879, p. 27.
[4] A. M. D. Reports, 1880, vol. xxii. p. 96.

How then shall we distinguish typhomalarial from enteric fever? The onset in both is similar, though sometimes more sudden in the former.

I should consider that though the absence of rose spots does not negative enteric fever, their presence, if they could be recognized with certainty, would exclude typhomalarial fever. Murchison[1] considers the spots the only sign by which enteric fever can be diagnosticated from remittent fever in some cases. Persistent and uncontrollable bilious vomiting, especially if commencing early in the illness, is in favor of typhomalarial fever, though, of course, vomiting may occur late with extensive ulceration in enteric fever. The greater frequency of vomiting in typhomalarial fever probably depends upon the more frequent implication of the duodenum and higher parts of the alimentary tract in the morbid process. The character of the stools may assist diagnosis if they are greenish or dark colored; but in both diseases they may have the ochre color common in enteric fever evacuations.

When the duodenum and upper parts of the intestine are chiefly affected in typhomalarial fever, the abdominal pain and tenderness will be most marked in the epigastrium, rather than in the right iliac region. Hemorrhage from the bowels occurs in enteric fever, during separation of the sloughs in the intestine, and epistaxis may also occur in the early stage of the illness. In typhomalarial fever hemorrhages may occur at any stage; and from the bowel (which would appear to be a not uncommon occurrence), from the mouth, nose, or urinary organs.

Pyrexia. In the course of the illness the temperature chart will often give a guide to the nature of the disease. The typical temperature chart in enteric fever is well known, and in a simple, uncomplicated case there would be little doubt as to the diagnosis. Speaking generally, the fever in typhomalaria would seem to run up more quickly, and become high earlier in the illness than would be the case in enteric fever. Its course would not be so uniform, and the daily range is greater in the former.

While at Suakim, Surgeon-Major Cotter mentioned to me that he had observed in India that, whereas in enteric fever the highest temperature of the day occurred in the evening, the daily acme of malarial fevers was usually about noon. My few observations led me to believe that this is not a constant occurrence. The delirium of malarial fever is said to come on earlier in the illness than it usually does in enteric fever.

It will be noticed that my points for diagnosis are mainly those recognized as helping to distinguish malarial fevers from enteric. These points of difference are more fully detailed by Sir Joseph Fayrer in his "Croonian Lectures,"[2] by Dr. J. Harley in Reynolds's *System of Medicine*,[3] by Dr. Russell in the *Epidemiological Society's Transactions*,[4] and by Dr.

[1] Murchison: Continued Fevers, 3d edition, 1884, p. 597.
[2] Op. cit.
[3] Art. Enteric Fever.
[4] Epid. Soc. Trans., vol. 4, part iv.

Lyon in the *Indian Annals of Medical Science*,[1] to whom I would refer those who would pursue this subject.

PROGNOSIS.—The immediate danger to life is probably no less than in enteric fever. Convalescence will generally be very much prolonged; and after-effects, such as follow malarial fevers in general, may be expected.

TREATMENT.—In the earlier stages, caution will suggest as strict a *liquid diet* as is necessary in enteric fever. When diagnosis has excluded the latter, and symptoms point to an absence of inflammation of the alimentary canal, a return to solid food may be permitted earlier, and with more safety, than in enteric fever.

Whereas in enteric fever aperients are contraindicated, there would seem to be some reason for giving a *mild aperient* in the early stages of typhomalarial fever, with congestion of the duodenal mucous membrane, and, possibly, also of the stomach. *Quinine* is the most important drug, and may be said to form a necessary part of the treatment. In enteric fever it will do no more than reduce the temperature, in typhomalarial fever it may check the disease.

Some would recommend us to observe the effects of quinine as an aid to diagnosis; but diagnosis should lead to treatment, not haphazard drugging suggest a diagnosis.

Stimulants will often be required, and are essential in prolonged and adynamic cases.

A most important aid to cure, when it can be carried out, is to get the patient away from the malarious district as soon as possible. This will sometimes give a chance of recovery in cases which would otherwise be hopeless.

I have tried in this paper to bring together the observations of many who have described what I understand to be typhomalarial fever, and so to draw up a systematic, and, I hope, fairly complete description of the disease.

I must again reiterate my opinion that typhomalarial fever should be considered a malarial disease, and absolutely distinct from enteric fever in its etiology and pathology. Its claim to be distinguished by a special name lies in the fact of its symptoms simulating so closely those of enteric fever.

If the review of the subject here presented does anything to hasten the clearer understanding of what is signified by the term, and of what cases ought to be described as typhomalarial fever, it will have justified the preparation of this paper.

[1] Typhoid Fever Discriminated from Remittent Fever Indian Annals Med. Sci., No. 28, 1871, p. 241.

WAKING-NUMBNESS:[1] A HERETOFORE UNDESCRIBED NEUROSIS.

By Andrew H. Smith, M.D.,

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Six years ago the following case came to my notice, and I have had constant opportunity to observe it since:

Case I.—A gentleman, forty-three years of age, in perfect health, and very actively engaged in professional work, experienced every time that he awoke from sleep a sensation of numbness in the ulnar distribution in each hand. The sensation exactly resembled that which results from pressure upon a nerve, and with which we are all so familiar, when, as we say, the foot goes to sleep. But it was soon observed that motion, sensation, and the tactile sense were entirely unaffected, while in the case of pressure upon a nerve, all these functions are suspended. The condition occurred independently of posture and of any other circumstance, save the essential one of waking out of sleep. If the patient dozed a moment in his chair, the peculiar sensation was sure to be present when he awoke.

For some months the numbness or tingling was confined to the little finger and the ulnar side of the ring finger, but gradually it spread over the whole of both hands, then up to the elbows, and finally reached the shoulders, and overspread the upper part of the thorax. Next, the tip of the tongue became affected, and in the course of two or three years the lips were included. Since then there has been no further progress; on the contrary, for the last year and a half the shoulders and chest have been exempt. The period during which the patient is conscious of the sensation does not exceed a minute. He thinks that for some time past it has been absent very frequently, but he has become so accustomed to it that it may pass unobserved, unless more than usually intense.

Quite often a position is assumed during the night in which the ulnar nerve is compressed. The opportunity is then afforded of contrasting the two conditions. In the ulnar distribution there will be paralysis of motion and sensation, and the tactile sense will be lost; while in the rest of the hand these functions will be intact. The feeling of numbness, however, will be uniform throughout the hand.

I have been able to collect three cases of this affection, besides the one described above. One was in my own practice, and the others in the practice of friends, to whom I am indebted for the histories. The second case in my own practice occurred in the person of a type-setter, forty years of age, who came under my observation November 5, 1886.

Case II.—No history of syphilis, rheumatism, or the alcohol habit could be obtained. Was well until five years ago, when, on waking one morning, he found himself partly paralyzed in the right arm and leg.

[1] A convenient name for this would be *narkephygmia*; ναρκη, numbness; *αφυπνόω*, to awake.

There was also some thickness of speech, which, however, soon disappeared. The paresis continued, and two years later was followed by a similar attack affecting the left side and the left half of the face. This attack was accompanied by intense abdominal pain and severe constipation, and was followed by œdema of the right leg. The paresis still continues, being most marked in the right leg. He drags the right toe in walking. He is cachectic and badly nourished, and there is a blue line along the gums. Has had several attacks of lead colic. The patellar reflex is diminished on the left side, and slightly exaggerated on the right. Umbilical reflex normal on the left side, absent on the right. Cremasteric absent on the left side, normal on the right. Plantar reflex exaggerated on the left side. Electro-muscular contractility everywhere normal.

Patient complains of a sensation of numbness or tingling in the fingers of both hands on awaking out of sleep. There is no impairment of motion, and he can appreciate the qualities of the bed-clothes, for example, by the sense of touch, as well as ever. There is no change in the appearance or temperature of the fingers. The sensation is always present on awaking, even if it be only from a short nap in the daytime. It passes off in the course of one or two minutes, without having recourse to rubbing or other means for its removal. Occasionally it is felt on the left side of the face and neck. The patient is an intelligent man, and his statements are very clear and definite.

The next case is furnished by Dr. S. H. Hunt, of Long Branch, N. J., and I will give it in his own words:

Case III.—Miss G. S., æt. twenty-five years, had, in August last, a severe attack of malarial dysentery, which lasted for one week, producing great emaciation and prostration. After a few weeks her recovery seemed complete, and she was able to perform her accustomed household duties. In the last week of November I was called to see her on account of a numbness of the right arm, which occurred only on her waking in the morning. It was referable to the ulnar side of the arm, and she complained mostly of those parts which received the terminal branches of the ulnar nerve. She stated that she had noticed it for the previous two weeks. There was no loss of motion or sensation, or of the tactile sense. It seemed to commence in the extremities of the fingers, and extended up the arm. She commenced rubbing her hand and forearm on waking, and this condition often lasted an hour or two. Knowing her previous history, and suspecting it might be attributable to malarial toxæmia, I gave her antiperiodic doses of quinine, twenty grains daily. On the first night she awoke at midnight, and said the sensation occurred at that time, but was very slight. On the repetition of the dose, there was an entire absence of the sensation, which led me to believe I had found the cause of the trouble. Much to my chagrin, there was a recurrence of the numbness on the third morning. Quinine, iron, and strychnine were then given as a tonic, but the sensation was persistent and obstinate for another week. This tonic, with a change of climate and absolute rest, ultimately gave her relief, and the peculiar numbness disappeared with her general improvement. Up to this date, January, 1887, there has been no return of it. The arm "being asleep," from the position in which it is placed, is a frequent occurrence, but this sensation at

waking, and lasting so long, has led me to inquire what is the *cause* or condition that gives rise to it.

The next case occurred in the practice of Dr. S. H. Burchard, of New York, and is furnished to me by his associate, Dr. H. A. Mandeville:

Case IV.—Mr. B. W. B., fifty-three years of age. Patient is now suffering from partial paraplegia dependent upon chronic myelitis. About six weeks ago patient began to complain of sensation of general numbness upon first awakening in the morning, which lasts until after free muscular movements of the body, when it gradually passes off; if the patient falls asleep again he experiences the same sensations, which are relieved in the same manner. During these attacks he has absolutely no loss of power; his common sensation, as well as his tactile sense, is perfectly normal. Urine contains a large quantity of oxalate of lime, and is highly acid, otherwise normal.

The patient has been in the habit of sleeping with his head very low, and, thinking that the numbness might be due to an impeded cerebral circulation, it was suggested that he sleep with his head higher. This was accordingly done, with relief to the more prominent symptoms in a few days, but he still complains of the numbness on first awakening.

From a study of these cases it is apparent that the numbness is something added to the normal condition, while nothing is subtracted from it. It is a purely subjective condition. There is no paralysis of motion or sensation, the tactile sense is unimpaired, there is no change in the temperature of the affected part, the surface is not blanched or mottled, there is no tenderness on pressure. These characteristics separate this condition widely from those known under the names of night-palsy, local asphyxia, digiti mortui, Raynaud's disease, erythromelalgia, and from the various paræsthesias and acroneuroses heretofore described.

Doubtless the conditions upon which the numbness depends are present during sleep, but the sensation is not sufficiently strong to arouse the sleeper, and he first becomes conscious of it when awakened by some other cause.

The cause of this condition is probably central, since the effect is usually symmetrical. It would seem to be connected with the lowering of the circulation which takes place during sleep, and to disappear when the circulation returns to the waking condition, whether the return be spontaneous, or the result of rubbing, etc. As to the latter, it is doubtful whether it has any other effect than that upon the general circulation which the muscular exertion would necessarily produce.

As for treatment, in the only case in which the condition existed by itself, and independently of more serious conditions, ergot, digitalis, strychnia, and aconite were tried at different times, but without result. The inconvenience produced by the affection was so slight, that no treatment was carried out efficiently, so that even these negative results were of no value. In each of the other cases there was a diseased condition

present, to which the numbness was subordinate, and which afforded the indications for treatment. In proportion as the treatment of the underlying condition was successful the numbness disappeared. If it be true that the cause is central, no local treatment is likely be of service.

A CONTRIBUTION TO THE MANAGEMENT OF GENERAL ATROPHY (SCLEROSIS?) OF THE CONDUCTING APPARATUS OF THE EAR.

By S. O. Richey, M.D.,
of Washington, D. C.

When discussing the nature of this affection in the *Archives of Otol.*, vol. xv., No. 1, 1886, attention was called to the fact that local stimulation, applied immediately to the diseased tissues, promises the most efficient results yet obtained, but no attempt was made to elaborate the details of management, or to describe the means of producing the desired effect in this peculiar region, difficult of approach, sensitive to and resentful of the presence of instruments and medicaments to which it is unaccustomed, and located so near the centre of the senses that many unexpected manifestations of their displeasure occur, which, though merely functional and temporary, are very disagreeable while they last. The necessity of repeating the manipulations and applications for a long time divests the procedure of any sentimental impressions it might otherwise leave. In the ratio of the rapidity of the increase of the impairment of hearing may we find an indication as to the length of time requisite for its proper treatment; for, the slower its progress, the more firmly will the disease changes have established themselves, and, therefore, the more difficult, and the longer the time necessary to remove them.

Empirically repeated incisions of the membrana tympani may, by the contraction of their cicatrices, restore the membrane to a *shape* more nearly normal, but what will be the ultimate effect of this scar tissue? May it not be worse than the condition it was devised to relieve?

No good reason, based upon pathology, is given for such interference, and I am convinced no thinking man will advise such a course, without a better reason than any yet advanced in its favor. An air-douche to the middle ear, unaccompanied by any other agent, is questionable therapeusis: it is a mechanical shock to a sick organ to be resented sooner or later; generally, at such a time that no connection can be traced.

Depressions of the membrana tympani, alteration in its translucency, thickening of its tissues, and the appearance suggesting adhesions are

probably due to changes in the mucous layer of the membrane and that lining the cavity.

Division of the tensor muscle, the use of Siegle's otoscope, forcible inflation, etc., have been resorted to for the purpose of relieving these features, often with the hearing improved to some degree after each, only to relapse into a worse condition with less prospect of improvement than before.

More frequently a flapping drum-head results, with pain and dizziness when blowing the nose, if there is not stenosis of the Eustachian tubes. The writer has often seen this condition following the too free use of the Politzer or the Valsalvan method of inflation, and generally in the ear not intended to be treated. With gentleness and care this misfortune may be corrected, but forms a long and tedious introduction to the necessary treatment of the original affection, when it happens to an ear already diseased, though it could be avoided by prudence in the beginning.

Too much stress is laid upon the fact that a drum-membrane is depressed, except as an evidence of the affection behind it, and producing it, the improvement of which establishes the proper position and condition of the membrana tympani in a perfectly natural way, by a removal of the cause: just as a pannus may often be cured by treating the conjunctivitis.

The morbid process in the cases under discussion does not, to our knowledge, cause death, and hence our opportunities are limited for completing their history by an autopsy, after close observation during life; and in this way only can the question be definitely settled; but it is not my impression that depression of the membrana tympani is so frequently due to retraction of the tensor muscle, or to adhesions to the inner wall of the cavity, as has been supposed, but, reasoning clinically, to shrinking of the mucous layer of the drum-head from atrophy, which slowly involves the whole membrane. The membrana tympani has, moreover, been seen to change in this feature, and in translucency, with the improvement from dryness and atrophy in the middle ear cavity, and that without special *force* from within. With the change in the mucous membrane toward health is associated a tendency of the membrana tympani to resume its natural and original position, and the less the solution of continuity of tissue has been in the membrana tympani, the better it should perform its function.

How much are we indebted to an atrophied condition of the conducting ear, for that variety of tinnitus, due, probably, to anæmia, which begins before there is any other prominent symptom of disease; which increases slowly, is very intractable, and often is not relieved until long after the hearing is improved? When this tinnitus is dependent upon disease of the naso-pharyngeal space, it is variable; that is, it is heard

sometimes in one ear; again, in the other; and, at another time, in both. It is relieved by restoring in the nasopharynx the natural relations for resonance.

Is persistent tinnitus in a given ear, when cerebral, circulatory, or nasopharyngeal causes can be excluded, not due to a disturbance in the character of the cavity; its moisture, its tension, form, size, etc.? Does not a modification of this alteration, by a topical application of therapeutic agents, offer us the best prospect of success?

The anatomical peculiarities of the tympanic cavity, its impatience of artificial control, and its resentment of the presence of foreign substances, limit, for the purpose of stimulation, the means at our command.

No *fluid* having this therapeutic value can with safety be carried beyond the isthmus of the Eustachian tubes, the danger being that, reaching the cavity, it will settle in the depressions, and by undue action there cause inflammation. We are thus confined to *vapors* for this purpose, because they diffuse themselves throughout the whole cavity without partiality and affect the entire lining membrane, producing no more influence in one locality than in another; they, at least, do this better than any other form of medication.

Chloroform or ether vapors have not been very efficient in my hands; for, while they cause considerable hyperæmia, this as readily passes off, unless so much vapor is used as to make the danger of acute inflammation so imminent that I have not felt justified in persisting with it. By very frequent application in moderate quantity, it might serve the desired purpose with diminished risk, but the object to be obtained is an almost *constant fixed action, an approximately continued influence*, and it is not easy to see how, with this agent, it can be accomplished. The mere odor of either chloroform or ether will cause nausea at once in some individuals, and generally does so with all, sooner or later; another reason for abandoning it.

My intention was to try a vapor of *chloroform and turpentine*, but the objections to chloroform were so pronounced, and the dread that the vesicular eruption and obstinate ulceration, which turpentine sometimes produces when applied to the skin, might be repeated in the mucous membrane, has so far deterred me from the experiment, which will probably be left to some one bolder.

Ammonia might be serviceable if it could be confined to the middle ear cavity, but its extreme volatility diffuses it through the pharynx and nares in a most uncomfortable way.

In circumstances of extreme difficulty we are apt to be content with what *has* answered the purpose in our hands, and my reliance has been almost entirely upon the vapor of iodine, with good, though not with uniformly satisfactory results.

The method adopted early in my practice is that which I first saw used

by S. J. Jones,[1] of Chicago, which is a modification and combination by him of several other methods. It differs from the Politzer methods in the substitution of the local anæsthesia bulb for the large bag, and *the use of the catheter*, which should be of malleable silver, as this may be readily adjusted in shape to pass through the nostril and reach the Eustachian orifice, anatomical variations being frequent on even the two sides of the same individual. In addition, being made of metal, it may be sterilized by dipping it in alcohol, and burning it out.

By these means we may be satisfied that the vapor reaches the objective middle ear cavity *first*, though the reflux reaches the air passages, from which it is not always desirable to exclude it; and, when it is, the severity of the application may be limited. The *smaller* bulb may be easily and firmly grasped in the hand, is readily compressible, and a measure of the obstruction of the tube, or of the pressure to which the membrana tympani is being subjected, may be ascertained by the resistance of the bulb to the hand. The light and flexible tubing, between the Buttle's inhaler and the hand-bulb, removes the risk of dragging upon the catheter when compressing the bulb; or of bending or breaking the catheter, as some of the books warn us, in describing the use of the Politzer bag with the catheter. *Hard-rubber* catheters are brittle, and require the aid of heat if a change in shape is desired, and for this reason are cumbersome. Besides, they are unclean, because they cannot be as easily and efficiently purified as can the silver instruments, as above suggested. Some silver catheters are rudely and inartistically made, and can be handled with no more facility than those of rubber, but the delicacy and ease of manipulation which can be acquired with the silver instrument, *properly* made, and the complete security against the danger from inoculation when it has been "purified by fire," add greatly to the comfort of the surgeon, and the comfort and safety of the patient.

The mechanical force arising from the quick *shocks* of air propelled by the hand-bulb has seemed to me as objectionable, only in a much less degree, as those inflicted by the large Politzer bag. The pressure in the middle ear cavity is temporarily very great, and a more steady and less forcible pressure must commend itself to our judgment. This I have secured by means of condensed air, with the aid of the air-pump and receiver ordinarily used by laryngologists in spraying the pharynx and the contiguous regions. With the "cut-off" which accompanies this instrument, we may have absolute control of the air-pressure in the middle ear, and if at any time the sharp impulse of air is desired, or deemed advisable, it is easily secured by this means.

[1] Trans. of the International Medical Congress, Philadelphia, 1876. "Modifications of the Methods of Treating Chronic Non-suppurative Inflammation of the Eustachian Tube and Middle Ear."

In the cases of so-called "*dry* aural *catarrh*," the Eustachian tubes are usually without obstruction, and a pressure of air sufficient to carry the vaporized medicament into the deep recesses of the ear seems sufficient. In my experience, this can be accomplished with a pressure varying from one-fifth to one atmosphere (three to fifteen pounds). The vapor, during the continued pressure, escapes into the pharynx and nares by the side of the catheter, and the return current meeting the advancing current near the orifice of the catheter produces a slight *rustling* sound, which is perceptible by means of the *auscultation tube*. The impingement of the advancing current of air upon the membrana tympani is also to be distinguished, if it reaches the cavity of the middle ear, by a light *blowing* sound.

It is best to suspend the pressure during inspiration, and to continue it during expiration; in this way avoiding, as much as possible, the extension of the vapor to the trachea, bronchi, and lungs, rendering it less disagreeable, and, with the assistance of the column of air expired, securing a more efficient application to the cavity. Besides, the expiration relieves the pharynx and nasal passages of the presence of the reflux of vapor as it escapes from the Eustachian tubes. A white handkerchief held to the nose has often been observed to be stained by the iodine vapor, which could reach it in no other way.

It has become my practice to *moisten* the sponges only when fitting them into the Buttle's inhaler, for by drying they adapt themselves to its shape better; not afterward, for the *crystals* of iodine evaporate with the air passing over them, as well when the sponges are dry as when they are moist. Constant use of the muscles of the forearm in compressing the hand-bulb is not without its risks to the surgeon, as it may induce morbid growths there; another reason for the use of condensed air.

Finding the hand-pump troublesome and inconvenient, my resort has been a hydraulic automatic air-pump,[1] which, being connected with the aqueduct water, gives a pressure of air equal to the pressure of water in the pipes supplying the house. It pumps air into the receiver as it is being exhausted, and maintains an approximately regular pressure. If the pressure of the water in the pipes reaches twenty to thirty-five pounds, it will be sufficient for all ordinary purposes, as the pump will act until equality is established between the pressure of the air and of the water. It is a great saving of labor and attention. The one in my office is known as "The Reliance," and was promoted from its original purpose of furnishing air pressure to beer barrels, to its present use. It is a handsome fixture, and can be obtained from Mr. Harvey, of Wash-

[1] Since the writing of the above and after using the apparatus, I find an account of something of the kind used for experimental purposes. Barth, Archiv. Otol., vol. xv. p. 160.

ington, put in position, for about forty dollars. A metal pipe runs from my receiver (which is on the floor) over my table, and is attached to the wall. This contains several stop-cocks, to which may be attached as many different apparatus for spray; between them and the reservoir is a governor which can be set to give the measure of air-pressure desired. By this last item guessing at the amount of pressure is avoided and accuracy may be secured.

The local application of iodized air will be followed by a feeling of warmth and an increase of secretion from the nares and pharynx, before it is perceptible in the ear by the patient, or before the surgeon can assure himself of its effect upon the ear by inspection. The *feeling in the ear* has been aptly described by a young woman, as "just like when you blush." As the vapor is driven into the ear first, the reflux into the pharynx and nares serves as a measure of the impression being made in the cavity of the middle ear, for, in some instances, it is not possible to produce any sensation in the tympanum, or to derive any information from an examination of the membrana tympani in the early stages of the treatment. In advanced cases of the disease no sensation is caused by the vapor for months; but, from the time it is first felt, there is steady increase in sensitiveness, and the severity of influenza following a sitting. This artificial influenza resembles any other, except that it is self-limited and of shorter duration, continuing from two to eight or ten hours; it is more easily produced and lasts longer as the treatment progresses. The use of the vapor has not, under my observation, occasioned anything resembling general iodism.

As it is needful only to maintain a state of hyperæmia as continuous as possible, the intervals between the interviews may be lengthened with the time the effect persists. Increased impairment of hearing and aggravation of any existing tinnitus may occur during the first week of treatment, and this naturally would not be unexpected in a state of tissue-thickening, a result of the hyperæmic condition of the membrane. It is apt to be alarming to the surgeon, unless he has had one experience or more; to the patient it will be disheartening, unless he has been previously advised of its probability, although it has not been observed in all cases. Why it should happen in some instances, only, is not clear, and the percentage of cases in which it does occur has not been ascertained. That it is due to congestion is proved by its occurrence each time the treatment is begun, after an interval of rest, and by the relation it bears to the intensity of the congestion. An improvement in these symptoms, corresponding in extent to their aggravation, takes place upon a discontinuance of the manipulations, which is noticeable in a month, or less, afterward, if the treatment has continued for several months.

If improvement takes place during the use of the vapor, this will be

increased, as indicated, after its suspension. Thus, generally, a gain can be decided only after a rest, which will not interfere with the ultimate result unless it lasts too long.

If the applications be too severe, or if the effect be increased by exposure to draught, or otherwise (and individuals vary greatly in liability to this accident), I have been able, with one exception, to control the resulting inflammation, by pressing against the membrana tympani a tampon of "prepared cotton," the end of which, in contact with the membrane, has been saturated with a solution of argenti nit. 1 : 100 parts. This, done early, often gives as immediate relief from pain as an anæsthetic. It should be left in position for some hours. The astringency reduces the local hyperæmia, and the tampon supports the membrana tympani and prevents its motion during the act of swallowing, or blowing the nose. The patient should be advised of the possibility of the accident, how best to avoid it, and to see the surgeon immediately when it occurs.

Iodized cotton in the external meatus is another means of using iodine. "Prepared" cotton placed in a closed vessel with crystals of iodine absorbs iodine, and parts with it again in the meatus. That this produces the symptoms, hyperæmia of the membrana tympani and external meatus, with some itching of the meatus, is proved in cases where the cavity is exposed by a perforation of the membrana tympani, as pain will result (though not when the drum membrane is entire) and will be relieved by removal of the cotton. The vapor applied to the cavity causes, in time, itching of the meatus in those cases which do well, and this fact induced me to use the iodized cotton in the meatus for its possible effect on middle ear nutrition, and that of the dermis of the meatus and the underlying glands. This application to the meatus is cleaner and more manageable than others, though it may be an advantage to substitute for it, sometimes, the ungt. hydrarg. nit. (pure, or mixed with lanolin in quantity varying to suit the condition), to the dermis. It is not in my power to say how much these aid the case, having never relied upon them alone in any instance, but they do service when the meatus is dry and exfoliating.

Electricity may serve to improve regional nutrition, as it does in trigeminal neuralgia, if a galvanic current be passed from the inferior cervical ganglion to the external meatus and to the Eustachian orifice, the difficulties being the time on the part of the surgeon required for each sitting, and the uncertainty of the result, for it would have to be tried alone to reach a decision as to its value.

To select a proper subject for this purpose, and to do it justice in respect to the individual and the agent both, is not a question of a short time. My reliance upon electricity, in controlling the action of the vasomotors of the region supplied by the branches of the fifth nerve, is

decided. In none but subacute cases has my observation, however, led me to think it acts promptly, and though my limited experience of its influence in cases of atrophy is not satisfactory, yet it is my hope at some future time to make more exact and reliable statements concerning it. Where stenosis of the inferior nasal strait exists, *electrolysis* accomplishes more than any other agent, except, perhaps, thermocautery. If a small silver catheter can be introduced at all, if not, a silver probe will make an excellent conductor, and with one pole at the nape of the neck, and the probe converted into the negative pole, absorption of morbid material may be caused, sufficient to admit the passage of a small catheter at a second interview. The current need not be strong enough to cause much pain. Absorption seems to continue for from a week to a month. Whether absorption of bone-hypertrophy takes place, I cannot yet say. Mayhap some further advantage would arise from the substitution of needles inserted into the diseased tissue, under the influence of cocaine, and electrolysis tried through them. It is a decided gain to avoid the *removal* of any essential part of an organ.

The use of the *steam atomizer*, in preparing the mucous surfaces for the action of the vapor, unnecessarily consumes the time of the surgeon and his client, without compensating advantage, as the stimulation by the vapor increases the quantity and fluidity of the secretion, and accomplishes the same purpose.

A spray *through the catheter* to the pharynx and posterior nares, and even into the Eustachian orifice, of argent. nit., 1; acidi borici, 7; glycerinæ, 20; aquæ, 500 parts, gives admirable results, when astringency is desirable. Unless forced into the superior meatus of the nares, or beyond the isthmus of the Eustachian tube, it is painless.

In this paper, discussion of the hygienic management is beyond the consideration.

A surgeon who is not full of courage both for himself and his client, who is afraid of labor, or who cannot persist patiently without seeing positive and rapid tissue change, should not undertake this class of cases, for the results cannot be brilliant in the length of time required, nor in their impression upon the ignorant, but are important chiefly to those who suffer. After a spasmodic, which always means an unsuccessful, effort, the difficulty is increased by the additional discouragement to that usually felt by these people. The object is not to claim anything miraculous even in appearance, but to make a decided statement that *all* these cases are *not incurable*, even when far advanced. The condition, the course of treatment necessary and its annoying accompaniments, and the possible expense, should be contrasted with the probable outcome if the disease is neglected, and the individual should be left to decide for himself what he should do. He will often conclude to take the chance of relief, thinking he will persist, but growing weary of the slow im-

provement he may give it up. This, in a measure, is his own affair; but, with this possibility in view, the surgeon does not feel very desirous of the responsibility, though he may have the satisfaction that he has done right in so far as he was permitted. I have never seen an instance in which there was not an amelioration of one or more of the symptoms after a time; a better feeling about the head; an improvement in conscious mental vigor, or in the memory; less tympanic neuralgia, or less tinnitus; increased ability to sleep, which is more refreshing; or an improvement in the power of hearing. In the event that the hearing is not improved, the surgeon, unfortunately, has only the consciousness of duty performed, as the better condition being confined to the patient himself, and not being perceptible to his friends, there is no credit to the surgeon, because the individual "did not get back his hearing." The organ is beyond the vision of all interested, except the medical adviser, and no one appreciates the influence of the *subjective* disturbances, except the physician and the patient, or realizes what relief from them means to the sufferer. The patient's friends, with the best intentions, are, in fact, because of their ignorance, his worst enemies, and a stumbling-block in the path of the surgeon, for they will, by united effort, sometimes convince the patient, contrary to his better knowledge, that there has been no change, as any advantage is so slowly gained that they become accustomed to it. Not infrequently the patient will say, "If I never hear any better, it is worth all the time, expense, and trouble to be relieved of the confusion and weight I have had in my head." One individual said some time ago, that "he would be glad to continue the treatment once a week for the rest of his life for this effect alone, as it had, for some years, been growing more difficult to do brain work, and he thought he must soon give it up." He was one of those who could hear only a loud voice in a moving car, or a din of some kind; a condition which we know to be very intractable. He now hears the ordinary conversational tone three or four feet distant in a quiet room.

This affection is one of such importance to so many people, interfering with their usefulness to society, their personal comfort and happiness, and the convenience of those brought in contact with them, that all knowledge in regard to it repays the endeavor. A faithful consideration of my contribution will prove it rational and in the right direction, so far as it goes, and it is hoped my *confrères* will give the patient attention and trial that the establishment of a reliable means of relief from this disease would deserve. Whatever this means may be, it cannot be speedy in face of the character of the disease. The treatment described unquestionably relieves *some* cases; it has been serviceable to nearly all for whom it has been tried. If some exist who would derive no benefit from it, *why not?* This is an important question, and it may be properly answered, that the trial was not long enough continued.

We must bear in mind that in all these cases the individual, or his friends, have been aware that something was wrong for years, and, knowing its rate of progress after the disease manifests its presence, we may confidently reason that it had been existent a very long time before that, so to impair the organ as to produce troublesome symptoms. A proportionate time and effort must be given to its relief. We patiently and persistently treat a chronic conjunctivitis and its sequelæ, and are encouraged to continue by our observation of the structural changes resulting from our efforts, and we must be guided and encouraged in the same way while attempting to improve this condition. We cannot rely entirely on restored function as evidence, for these people are more miserable than the blind, when they become profoundly deaf, without the element of maddening tinnitus which is so often present, and which so wears on the physical strength and the mental equilibrium, ceasing neither day nor night, that it must be an important factor in the causation of insanity and suicide. From a humanitarian view the result striven for is great, and any one who has even temporarily suffered in this way can appreciate what it must mean to be without hope of relief—*incurable.*

BACTERIOLOGY.

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(FOURTH PAPER.)

Of the methods of investigating bacteria, there are three that are most important, viz.: (I.) The study of their characters by the aid of the microscope; (II.) their investigation by means of cultivation; and (III.) the study of their relation to the living body. The chemistry of their products is also very important, but the methods of chemical analysis can be found in works on chemistry and need not, therefore, be detailed here.

I. Microscopical Investigation.

It is unnecessary to go into details as to the construction and the theory of the microscope, but I may mention the chief practical points in using it. The objects being minute and delicate, accurate illumination and fairly high angled lenses are necessary.

The lenses required are a low power ($\frac{1}{2}$ inch) for adjustment, an intermediate power ($\frac{1}{4}$ or $\frac{1}{6}$ inch) to get a general view of the relation of parts, and high powers for exact examination. Of the high powers, the

oil immersion lenses are the best, for two reasons: in the first place they are high angled and give a good picture and more light, and in the second place an adjustment collar is not absolutely necessary, and thus much time and trouble are saved. For most purposes $\frac{1}{12}$ oil immersion is sufficient, but $\frac{1}{18}$ and $\frac{1}{25}$ may also be obtained. The latter lenses not having, as a rule, such a high angle of aperture as the $\frac{1}{12}$, do not really show more detail; they merely show the objects larger.

Dry and water immersion high power lenses must be provided with a correction collar which enables the front and back lenses of the combination to be approximated or separated according to the thickness of the cover-glass; and, as cover-glasses vary much in thickness, the lens must be corrected for every specimen. In correcting a lens a high eye-piece must be used so as to magnify the defects as much as possible. Some delicate object is fixed, such as a delicate line, a group of granules, etc., and the collar is moved in one direction till it is evident that the picture is becoming worse; it is then moved in the opposite direction till the same thing happens, and so backward and forward in gradually diminishing distances till at last the best point is determined. In the case of oil immersions, it is well, also, to have a correction collar, for the oil is never of exactly the same refractive index as the glass; but, unless for very fine work, it is not necessary to alter it when the best average position has once been ascertained.

The microscope stand should be very steady and provided with a coarse and fine adjustment. The fine adjustment should work smoothly, slowly, and equably, otherwise it will be a matter of great difficulty to bring the object into accurate focus when using a high power. This is a matter of great importance. In most microscopes where the movement is obtained merely by a screw and a spring, the fine adjustment is imperfect, the parts get dirty, and the spring does not act instantly and steadily; hence the lens shoots past the focal point and exact focussing with very high powers is almost out of the question.

In bacteriological work a mechanical stage is often of great advantage. This is particularly the case where the whole specimen must be thoroughly searched for bacteria, and also where one wishes to find and resume the study, at a future time, of any special bacterium or group of bacteria. For the latter purpose a finder is necessary, the usual plan being that the fixed part of the stage is graduated on two sides and the amount of horizontal and vertical movement is read off. By placing the specimen and the movable stage in the same position, the object will be brought into the field of the microscope. Another very good method is by using a Maltwood's finder. Rotary stage movement is not necessary.

The substage arrangements are of the greatest importance. A wide-angled condenser is essential and it should be, if possible, achromatic. The substage must be provided with a coarse adjustment by which the

condenser may be raised or lowered, and for fine work a fine adjustment in addition is an advantage. There must also be screws for centring the condenser. Rotation of the substage in not necessary for bacteric work. Diaphragms of various sizes are required; one of the best forms of diaphragm being the iris diaphragm, by means of which the amount of light admitted can be varied with the greatest ease.

The proper arrangement of the illumination is one of the most important parts of microscopy, though often neglected by investigators. The first point is to centre the condenser. This is done by using the smallest diaphragm, and, after the specimen is brought into view with the low power object-glass, racking down the condenser till the ring of the diaphragm appears sharp. By means of the centring screws this ring is brought into the middle of the field. Having centred the condenser, use a larger diaphragm or none at all, and rack up the substage till the source of light is sharply in focus at the same time that the specimen is well seen. When working with lamplight it is easy to focus the source of light and to get the flame of the lamp quite sharp, but with daylight it is not so easy. In the latter case it is better to focus some object at a little distance off, such as the branch of a tree, a chimney, etc.—the focus will be almost the same for clouds or sky. The centring of the condenser may require alteration when fresh lenses are used, because the position of the axis of each lens when screwed on to the tube is not always exactly the same. Hence if, when working with lamplight the flame is seen to have moved to one side of the field when a new lens has been put on, do not alter the position of the lamp but bring the flame into the centre of the field by means of the centring screws. When using the higher objectives the condenser can be still more accurately focussed by means of the fine adjustment. The centring of the condenser requires to be done only at the beginning of the day and needs attention only when new lenses are used; the focussing of the condenser must be done for every specimen unless, indeed, slides of exactly the same thickness are used throughout. As the slides are thicker or thinner, so must the condenser be approximated or removed in order to bring the source of light to a focus on the specimen. It is thus evident that good microscopes must have a coarse adjustment for the condenser and also centring arrangements. Those which have the condenser fixed or only sliding, and no centring arrangements, are bad. Oblique illumination is not required in this kind of work.

As to the source of light, we may use daylight or artificial light. Of artificial light the best is a paraffin lamp. Each of these has its advantages. My own opinion is that for high powers lamplight is best; the source of light is fixed and the light can be accurately concentrated on the point under examination, and in this way one can get more light and can apply it more accurately than with daylight, especially if one employs

the edge of the flame, which gives about four times more light than the flat flame. On the other hand, for low power work daylight is undoubtedly the best. It fills the field equally, not being more intense at one part than another, while with lamplight, if the edge of the flame is used, only a narrow streak of light is seen in the centre of the field and a general survey cannot be easily obtained, while at the same time the illumination at the one point is too intense. It must be remembered that in using a condenser a flat mirror should be employed.

Very convenient lamps for microscopical work are made by Messrs. Swift & Beck. They consist essentially of large flat reservoirs for the oil. The chimney is a metallic one with a space on one side into which an ordinary microscopic glass slide can be slipped. The chimney can be turned round so that the glass slip may be brought opposite either the edge or the flat flame. The advantages of these lamps are that having a large reservoir they burn for a long time; that the reservoir being flat the lamp can be lowered much more than usual; that the light passes through a flat instead of a curved piece of glass; that the rest of the chimney being darkened there are no reflections; that if the glass breaks a fresh glass is always at hand and that the edge or flat flame can be used at will. The only difficulty about these lamps is that the glass is very apt to break. This may be avoided by selecting a thin glass and boiling it for some hours in water or oil before using it or by turning up the flame at first only very slowly. In using the lamp the light can be reflected into the microscope by means of a flat mirror, or the microscope may be tilted so that the light passes directly from the flame into the tube of the microscope, and this is the more satisfactory method when it can be employed. With lamplight it is well to interpose a piece of blue or neutral tint glass to remove the yellow color and make the light pleasanter to the eye. For this purpose colored glass of various intensities should be at hand.

I may sum up these remarks in the following rules:

1. Use a low power objective and a low eye-piece and place the specimen on the stage of the microscope.

2. Remove the diaphragm and rack up the condenser till it almost touches the slide.

3. Bring the specimen accurately into focus and leave it so.

4. Put in the smallest diaphragm and rack down the condenser till the hole of the diaphragm is sharply seen.

5. Centre the condenser by bringing this hole into the middle of the field. (4 and 5 need not be repeated more than once.)

6. Substitute a larger diaphragm and rack up the condenser till the source of light is accurately defined—the edge of the flame, branch of tree, etc. With lamplight it is best to dispense with the mirror and to place the lamp about eight inches from the condenser.

7. See again to the focussing of the specimen and be sure that it and the source of light are both at the same time accurately in focus.

8. Substitute the high power objective, again focus the specimen, and, if necessary, focus the light still more exactly. If the light (edge of the flame) is not quite in the centre of the field, bring it in by means of the centring screws, but do not move the lamp.

9. If the objective is a high dry power or a water immersion, it must now be corrected for the thickness of the cover glass. To do this, substitute a high eye-piece for the low one, and move the screw collar alternately in one or other direction till the sharpest picture is obtained.

The centring of the condenser (4 and 5) need only be done when one sits down to use the microscope, but the focussing of the condenser and the correction of the lens must be repeated with every new specimen. At first sight it may seem irksome to do this, but very soon one learns to do it quickly, and the gain in clearness, definition, and satisfactory examination of the specimen amply repays all the trouble.

In the investigation of bacteria the microscope is used for the examination of unstained and stained specimens. Of these the most valuable are the stained specimens, but as this involves the death of the organisms it is often necessary to study them without staining in order to see their normal form and structure, and to ascertain their characteristics, especially as regards the power of movement, mode of growth, grouping, etc.

A. Unstained Specimens.—In examining unstained specimens it is necessary to cut off a large amount of light by means of diaphragms, but the other arrangements of the microscope in respect of focussing and centring the condenser must be carried out in the manner just described. The bacteria to be examined without staining may be present in sections, or growing in fluid or in solid cultivating media.

It is but rarely nowadays that one examines bacteria in sections without staining them, but this was the method chiefly employed before the affinity of these organisms for the aniline dyes was discovered. In the unstained condition it is often difficult to distinguish the microorganisms from the tissue elements, and in order to do this with some degree of certainty the section is washed in acetic acid and then mounted in glycerine. Bacteria resist this treatment, while fatty and other materials are acted upon, and hence if groups of well-defined granules, all of the same shape and size, or of rod-shaped bodies are seen, they are in all probability microörganisms. Baumgarten succeeded in demonstrating the tubercle bacillus about the same time that Koch published his first paper on the subject, by subjecting sections of tuberculous tissue to the action of weak caustic potash; the tissue elements became invisible or less visible than usual, while the bacilli stood out markedly, having resisted the action of the alkali.

In examining pure cultivations of bacteria in fluids or solids, care must be taken not to let foreign bacteria into the cultivations from which the specimens are taken. The fluids may be obtained by using a thin platinum wire fixed in a glass rod and twisted into a loop at the end. The whole of the wire as well as the lower part of the glass rod must be carefully heated in the glass flame; when cool it is dipped into the flask, and a little of the fluid is picked up in the loop of the wire. Portions of fluid may also be removed by means of a sterilized pipette, the vessel containing the cultivation being held obliquely and the movements performed rapidly. Or, still better, a syringe may be employed, to the end of which a bent piece of glass rod is attached by India-rubber tubing; the glass rod is sterilized and introduced into the flask and a small quantity of the fluid drawn up by means of the syringe. If a small syringe with a ring at the end of the piston be employed, the whole manipulation can be done with one hand, the syringe being held in the hand and the piston withdrawn by means of the little finger passed into the ring.

The drop obtained by one or other of these methods may be examined by simply placing it on a slide and dropping a cover-glass on it. In this case care should be taken to have an air-bubble under the cover-glass, for it is often very difficult to focus a thin layer of fluid, while the margin of the air-bubble is easily defined and thus leads to the layer. This method is not sufficient if the examination is to be continued for some time, because evaporation occurs readily and also because there are very apt to be distracting currents, especially if an immersion lens be used. To avoid these inconveniences it is best to use cupped slides or glass cells. A small drop is placed on the middle of a large cover-glass, a little vaseline is put round the side of the cup or of the cell, the slide is turned upside down and dropped on the cover-glass so that the drop is in the centre of the cell, very slight pressure diffuses the vaseline and makes the cover-glass stick to the slide, and the slide is then quickly turned up so that the cover-glass is on the top with the drop hanging from its under surface. Where the observation of the drop is to be continued for some time, as where the mode of growth, spore formation, etc., is to be watched, the slide and cover-glass should be sterilized in the flame and the manipulations performed as quickly as possible. With regard to the cover-glass, care must be taken in passing it through the flame that it does not get too hot, otherwise it bends and does not lie flat on the top of the cell. If it is necessary to keep the cultivation, while under observation, at a temperature above that of the air, one or other form of hot stage must be employed instead of the cupped slide; but as the methods of using these are described in all books on microscopy, I need not go into that subject here.

Where the bacteria are growing on some solid material, a minute

quantity is picked up with the sterilized needle and diffused in distilled water, salt solution (one-half to one per cent.), or cultivating fluid, and examined as above. It may also be necessary to examine bacteria *in situ* when growing on or in solid media, but this will be referred to afterward under "plate cultivations."

B. Stained Specimens.—The amount of information derived from the examination of unstained specimens is, however, comparatively small, and, therefore, in most cases recourse is had to the various methods of staining. It is only quite recently that satisfactorily stained specimens of bacteria have been obtained. The older attempts at staining were made with carmine and hæmatoxylin, but only a few species take on these stains, and in no case can the result be called good. With Weigert's discovery of the affinity of bacteria for certain of the aniline dyes, the state of matters has, however, been completely altered, and the work of Weigert, Koch, Ehrlich, and others, has led to great advances in this department of bacteriology. In resorting to stained specimens, the investigator may wish to study the bacteria alone, quite apart from their surroundings, or he may desire to ascertain their relations to the elements of the tissues in which they occur. In the former case what are termed "cover-glass preparations" are made; in the latter, sections of the tissue are employed. As the preparation and treatment of these two sets of specimens differ in several important particulars, it will be well to consider them separately.

1. *Cover-glass preparations.* These are employed when one examines bacteria in fluids, or in cultivations, etc., or when one wishes to gain an idea of the presence and probable numbers of these organisms in tissues without studying precisely their relations to the tissue elements. The method consists in spreading out the material in a thin layer on one side of a cover-glass, and fixing this layer to the glass. The material may be spread out by means of a needle, the point of a knife, etc., but the best way of obtaining an extremely thin and even layer is to take two cover-glasses, put a minute quantity of the fluid on the centre of one, drop the other glass on the top of it, press them together so as to diffuse the material over the glass, and squeeze out any superfluous fluid; then, keeping up the pressure, slide them apart and set them up on their edge to dry under protection from dust. They dry in a very short time, but if one wishes to hasten matters, they can be held in the fingers at a considerable distance above a flame; they must not, however, be actually heated while still moist, and by holding the glass in the hand instead of in forceps one takes care that they are not brought too near the flame.

In other cases the material may be too thick to spread out in the manner above mentioned; it must, therefore, be diffused in a drop of boiled distilled water. Where water is thus employed there is always

the difficulty that after the cover-glasses are slid apart the water collects in drops as on a duck's back, and little heaps of microörganisms are obtained. It is therefore better when water is used not to press the drop between two cover-glasses, but to let it dry on one glass. It will be found that while at the centre there will probably be too many bacteria, at the circumference of the drop one will find satisfactory places. This is also the best way of preparing drop cultivations for staining The cover-glass from which the drop is hanging is turned over and the fluid allowed to dry. Where the material is very dense, as, for instance, a small tubercle, it is best to crush it well between two knives and then rub the crushed mass over the surface of a cover-glass, afterward removing the superfluous solid material. Lastly, we have what the Germans call "Klatsch" preparations, which are made in the following manner: As will afterward be pointed out, it is often important to study the mode in which various organisms spread over the surface of solid materials. When growth has occurred to some extent, a cover-glass is dropped over the spreading part, pressed lightly, and then lifted. The cover-glass picks up the bacteria, and when the specimen is dried and stained, one gets an exact impression of the mode of surface growth of the organism in question. These "impress preparations" are often very beautiful and valuable.

Cover-glasses prepared in any of these ways can be kept in a dry place for a long time without undergoing any change or losing their property of staining, and it is often necessary to keep a number of specimens of the same material either for future reference or for trying new stains or testing the activity of staining fluids which may have yielded negative results with other specimens. This is especially the case with tubercle. The stain ordinarily used for staining tubercle bacilli is very apt to go bad in a few days, and, therefore, I always keep a number of prepared cover-glasses of sputum or other material rich in tubercle bacilli at hand, so that if a negative result is obtained I can stain one of these glasses and see whether the result is due to some fault in the stain or to the absence of bacilli.

A layer having thus been obtained, it must be fixed before proceeding with the staining. If the layer contains albumen, the albumen is not coagulated by simple drying and, therefore, when placed to stain in a watery solution the albumen dissolves and the layer becomes detached. And even if any portion of the layer remains, that is not of much use, as precipitation of the stain occurs in connection with the albumen. It is, therefore, necessary to coagulate the albumen before proceeding with the staining and at the same time to retain for bacteria and nuclei their power of taking up the dye. This was done by Koch at first by placing the cover-glasses for some days in absolute alcohol. But this is a tedious method and one of the great advantages of these cover-glass prepara-

tions is that they can be prepared and stained in a very short time. Ehrlich found that if cover-glass specimens of blood were kept for an hour at 100° C. to 115° C. the desired coagulation was obtained without interfering with the staining of the nuclei, etc. Koch has applied this method to bacteric work, and at first recommended placing cover-glasses for an hour in an iron chamber kept at about 110° C. Ehrlich's method is simpler. He takes a long strip of metal, supports it on a tripod, and places a Bunsen's burner under one end. After about a quarter of an hour a wet rod is drawn over the metal from the cool end toward the flame. At a certain point it will be seen that the water boils. That line is, therefore, at 100° C. and its exact position is carefully ascertained. Cover-glasses with the coated surface upward are laid on that line or a little nearer the flame and kept there for an hour. As the best temperature varies for different materials, it is easily ascertained by using three or four cover-glasses and laying them at slightly different distances from the flame. One of them will be good.

Where one wishes to obtain really beautiful specimens for preservation the above is the best method, but it has been found that sufficiently good specimens are obtained by seizing the cover-glass in a pair of forceps with the spread side upward and passing it fairly rapidly three times through a glass flame (about as rapidly as one cuts bread—Rindfleisch). If it is passed too often through the flame, or if it is heated too long on the metal plate, the bacteria lose their property of taking on the stain.

Having thus prepared the specimens they must next be stained. This is much easier to do in the case of cover-glass preparations than in that of sections, but different kinds of bacteria stain differently. One of the most satisfactory stains to use is a fairly strong watery solution of methyl-violet. I do not make it up on any precise formula, but add a stock saturated alcoholic solution of methyl-violet to distilled water till a deep color is obtained. I should guess that the proportions are about one part of the methyl-violet to ten parts of water. A few drops of this are filtered into a watch-glass and then the cover-glass being held between the finger and thumb with the covered side downward, it is dropped on the stain and allowed to float there for five or ten minutes. It is then removed and washed repeatedly in dilute acetic acid (one-half to one per cent.) till no more stain comes out. It is afterward rinsed in distilled water and examined in the water. If a permanent preparation is required, it is then dried in the air and when quite dry is mounted in Canada balsam. If it is dried at a high temperature, the stain disappears and this is the case with all stained specimens; they should not be heated after staining. The specimens should always be examined in water in the first instance, because there the bacteria swell out to their natural size (more especially when acetic acid is used), whereas they dwindle and shrink somewhat when dried and mounted in Canada

balsam. The use of acetic acid in the manner described above is much more satisfactory than that of alcohol for removing the superfluous stain and differentiating the nuclei and bacteria, and if the specimen is somewhat overstained to start with there is no danger of leaving it too long in the dilute acetic acid.

The Canada balsam is best employed in the form of a solution in xylol. The only other solvent that can be used is turpentine, as chloroform and benzol extract the aniline colors. Undissolved balsam cannot be used, for the heat required to dissolve it is apt to remove the stain from the bacteria.

Gentian-violet may also be employed in the same manner, or in a one per cent. watery solution, but the color is hardly, I think, so pleasant as that of methyl-violet, and for cover-glass preparations it does not possess any advantage. One of the quickest stains is a watery solution of fuchsin. This should be almost saturated and well filtered. If it is quite saturated precipitation is apt to occur on the specimen as evaporation takes place. The cover-glass is laid down with the spread side uppermost and a drop of the stain is placed on it. After about a minute the stain can be washed off with distilled water or weak acetic acid and the specimen examined.

Methylene-blue is almost more universally useful than methyl-violet, but the stain is not so intense. It may be used in the form of a strong watery solution, or it may be made in the same way as methyl-violet by the addition of a saturated alcoholic solution to water, but in larger proportions than in the case of methyl-violet. The watery solution stains a light blue or almost a green, but a beautiful deep blue is obtained if a little methylic alcohol be added to the solution, or if the saturated alcoholic solution be made with methylated spirit instead of with absolute alcohol. After staining in methylene-blue acetic acid should not be employed; simple washing with distilled water is sufficient.

The staining power of these solutions may be increased in two ways: either by warming the solution, or by the addition of various bodies, chiefly alkalies, and the alkaline solutions also act more quickly and powerfully when warmed. These facts were first made out in connection with Koch's discovery of the tubercle bacillus, and have since been extended to other bacteria.

Koch's first method of staining the tubercle bacillus was by the use of an alkaline solution of methylene-blue. He first made a watery solution of caustic potash of the strength of 1 to 10,000. To every 200 c. cm of this solution he added 1 c. cm of a saturated alcoholic solution of methylene-blue. The cover-glasses, which are prepared from tenacious pieces of yellow sputum or from crushed tubercles, are floated on this solution for twenty-four hours or longer, and are then placed in a saturated watery solution of vesuvin or Bismarck-brown for twenty to thirty

minutes. They are then washed in water and examined at once or dried and mounted in Canada balsam. As the result of this treatment all bacteria, nuclei, etc., become in the first instance intensely blue, but the effect of the vesuvin is to substitute itself for the blue in the cell nuclei and in all the bacteria except the tubercle bacilli. The effect is that we have blue-stained tubercle bacilli on a brown ground. This method is, however, somewhat difficult to carry out, and it is somewhat difficult to see the tubercle bacilli, hence the plan was very soon improved.

The first improvement and that which still holds the field, was the use by Ehrlich of aniline oil instead of alkalies. Ehrlich's original plan was to make a watery solution of aniline oil by shaking up the oil with water (about three per cent. of the aniline is taken up) and filtering the turbid mixture through a moist filter. To this was added a saturated alcoholic solution of fuchsin, methyl-violet, or gentian-violet, till precipitation began to occur. Weigert has worked out the best proportions in which these two should be mixed, and gives the following formula:

Saturated watery solution of aniline	100 c. cm.
Saturated alcoholic solution of fuchsin, methyl-violet, etc.	11 "

The cover-glass is floated on this solution for about twenty-four hours at the ordinary room temperature, but three or four hours are quite sufficient at the body temperature, and if the staining fluid is heated almost to boiling a few minutes are enough. The most satisfactory result is obtained when the material is kept at the body temperature for two or three hours. When the cover-glass is removed from the staining fluid the whole layer is intensely stained and the individual structures unrecognizable. It is now immersed in dilute nitric acid (1 part of strong nitric acid to 3 or 4 parts of water) for a few seconds till the layer becomes bleached. The result of this is that while the stain remains fixed in the tubercle bacilli it is, so to speak, loosened in the other elements and easily removed by means of alcohol, or displaced by a contrast stain. If the cover-glass is washed in water after being taken out of the nitric acid the color returns (red or violet, according to the stain used) and is then less easily displaced. Hence some advise that the cover-glass should be placed at once in alcohol not quite absolute, after being removed from the nitric acid, but my own impression is, that it is better to wash away the acid first in water, as acid alcohol is apt to remove the stain from the bacilli unless they are very well stained. In any case, when the cover-glass is placed in alcohol it is left till no more stain comes out, and is then stained with a contrast stain, either a watery solution of methylene-blue made up as before described, if the primary stain was fuchsin, or a saturated watery solution of vesuvin if the primary stain was violet. When sufficiently stained they are washed in water and examined, or dried and mounted in balsam. The result is that the tubercle bacilli

are red or violet as the case may be, and the nuclei of the cells and the other bacteria are blue or brown. Treated in this way, the only other bacteria, so far as is yet known, which retain the primary stain are the bacilli of leprosy. The spores of some large bacilli retain the primary stain, and elastic tissue and cheesy matter, especially the former, also retain it to some extent.

Stains made up according to the above formula become bad in a few days and must therefore be frequently renewed. This difficulty has been got over by avoiding the use of alcohol altogether, and the fluid now used in Koch's laboratory for Gram's method, tubercle bacilli, etc., is made up as follows: A saturated watery solution of aniline oil is made and filtered as above. This solution is then employed for preparing a saturated watery solution of fuchsin, methyl-violet, or gentian-violet, a large quantity of crystals of these substances being put into a bottle containing the aniline water. The fluid is filtered before use, and when exhausted fresh aniline water is added as long as any crystals remain at the bottom. This staining fluid remains good for a long time.

The mode of action of the aniline is not very clear. Ehrlich used it on the supposition that the difference in staining reactions between ordinary bacteria and tubercle bacilli depended on the tubercle bacilli possessing a sheath which can only be penetrated by coloring matters in the presence of alkalies, and which becomes impenetrable after the use of acids. But there are various facts which render it doubtful whether alkalinity is the essence of the matter. My own idea is that the aniline acts merely as a sort of fixing agent. I found[1] in my investigations on tuberculosis that the tubercle bacilli could be stained by the ordinary dyes without any aniline, but that only a few of them, probably at a certain stage of growth, could retain the stain in the presence of strong nitric acid. This is what the aniline enables them in some way or other to do. Other investigators, especially Baumgarten, have also found that these bacilli stain without the aniline. And even in the case of other bacteria the addition of aniline to the stain is an improvement, and indeed almost an essential in some instances.

Other substances have been employed to replace aniline, and with a considerable degree of success. The chief of these is a five per cent. solution of carbolic acid, first suggested by Dr. Franz Ziehl. Neelsen has modified Ziehl's solution and suggests the following:

Fuchsin	1 gramme.
Absolute alcohol	10 c. cm.
5 per cent, watery solution of carbolic acid . .	100 c. cm.

This is used in the same manner as the Weigert-Ehrlich solution, or the stained cover-glasses may be washed in a watery solution of sulphuric

[1] Practitioner, April, 1883.

acid (25 per cent.), instead of in nitric acid. The carbolic stain gives very brilliant results. Ziehl also succeeded with resorcin and pyrogallic acid, but the results are not so good. I have tested other substances, the best of these being phloroglucine, which acts almost as well as aniline. Toluidine is also good. Weigert recommends the following solution:

Liq. ammon. fort.	5 c. cm.
Absolute alcohol	10 c. cm.
Distilled water	90 c. cm.
Gentian-violet	2 grammes.

This is used in the same manner as the others.

Gram's method of staining bacteria gives beautiful results in some instances, but it is not often necessary to use it in cover-glass preparations. Hence we may leave its detailed description till we come to sections, and the same may be done with regard to the other special methods, such as those for syphilis, double staining, etc.

Staining with vesuvin or Bismarck-brown was at one time much used in order to obtain specimens for photography, but since the introduction of the new plates by which blue and red stained specimens may also be photographed, this has fallen into disuse. One way of using the brown is to stain in a saturated watery solution of vesuvin, wash in water and examine, or dry and mount in Canada balsam. The method recommended by Koch was, however, to make a concentrated solution of vesuvin or Bismarck-brown in equal parts of glycerine and water, filtering before use. The specimens were afterward mounted in glycerine.

Quite recently it has been found that spores which, when completely formed, remain unstained when treated with the ordinary aniline dyes, can be stained by a special method. Koch and Gaffky noticed, when staining material containing tubercle bacilli with aniline methyl-violet, that not only the tubercle bacilli, but also the spores of a large bacillus retained the blue, while the other bacteria, and indeed the bacilli containing these blue stained spores, took on the brown stain. Hence there was here a differential staining of spore and adult bacillus. By using the same method, however, the spores of other bacteria could not be stained, but Neisser succeeded in getting double staining in other cases by using warm aniline fuchsin, and subsequent staining with methylene-blue; the spores remained red, the rest of the rod became blue. Buchner and Hueppe have worked out the matter, and Hueppe has obtained both isolated staining of spores and double staining of spore and rod. The isolated staining of the spore is managed in this way: if the cover-glass is passed through the flame oftener than three times, the staining property of the bacteria and protoplasm is diminished, and after passage through the flame six or ten times they do not stain at all. On

the other hand, after the preparation has been passed through the flame from seven to ten times the spores acquire the property of staining with watery solutions of the basic aniline dyes, so that an isolated staining of the spores is the result. Hueppe also obtains double staining in the following manner: The cover-glass is passed through the flame three times, and then stained for ten to twenty minutes in a warm solution of aniline fuchsin (as used for tubercle). After removal from this solution it is washed in water, and then either stained with methylene-blue or placed for a few seconds in absolute alcohol, and then in the contrast stain. The spores come out red, the bacilli blue.

The flagella with which some bacteria are provided are said not to take on the aniline dyes, though I doubt if this statement is correct in all cases. On the other hand, they can be stained in a concentrated watery solution of hæmatoxylin.

Much more difficult than these cover-glass preparations is the manipulation of sections of the tissues. In this connection we have to consider the methods of hardening, of cutting, and of staining.

2. *Sections of the fresh tissues* may be made by means of freezing microtomes without any preliminary hardening, but the sections are not easily manipulated and in many cases the staining is most unsatisfactory. Hence it is best, whenever possible, to harden the tissues. If the fresh tissue is cut, the sections should be received in salt solution (one-half per cent.), and then placed by means of a spatula in absolute alcohol for a few minutes. From this they come into the staining fluid, and the best, for this purpose, is a saturated watery solution of vesuvin.

Of the hardening reagents the most useful is absolute alcohol, but Müller's fluid or a strong watery solution of bichloride of mercury may be employed. The tissues must be cut up into small pieces and placed in a large quantity of absolute alcohol, which should be frequently changed. Treated in this way the tissue is sufficiently hardened, and, indeed, in its best condition for staining in about three days. After several weeks' immersion in alcohol some bacteria do not stain so well as at first, and hence to keep the tissues permanently one should not use absolute alcohol, but a weaker alcohol: methylated spirit does very well for this purpose. In Müller's fluid (potassium bichromate, 2 grammes; sodium sulphate, 1 gramme; distilled water, 100 c. cm.) the tissues must be kept for from two to three weeks and are then ready for cutting, or after removal from Müller's fluid they may be placed in dilute alcohol and then transferred to and preserved in strong alcohol.

The tissues hardened in alcohol are best cut with a microtome, either a freezing microtome, or one for cutting under alcohol. If a freezing microtome is used, the alcohol must be first removed from the tissue by placing it in a large quantity of water. At first the tissue floats but after a short time it sinks, and in an hour or two it may be placed in a

thick solution of gum. It remains in this for some hours to allow the gum to soak thoroughly into it. It is then frozen with either an ice or ether freezing machine. The best freezing microtome is, in my opinion, Williams's, and this can be easily arranged to act with ether. If ice is used, a few drops (six or eight drops per ounce) of methylated spirit should be added to the gum to prevent it freezing too hard, but with the ether machine this is not necessary as it is quite easy to regulate the degree of hardness of the gum. When cut the sections are placed in tepid water to dissolve out the gum, and are then removed to alcohol before being placed in the stain. In the case of Müller's fluid, the tissues may be placed at once in gum and then treated in the same way as the other.

At one time I used to prepare all the sections in this way, by first hardening the material in alcohol and then freezing, because very fine sections were thus obtained, but though this plan answers very well in the case of some bacteria, such as tubercle bacilli, I have come to the conclusion that on the whole a better result is obtained if the tissues are not placed in water after hardening, but are cut under alcohol. And after all, though the sections are a little thicker, this is no disadvantage, for one is less likely to miss the bacteria if they are few in number than when a very thin section is employed. For this purpose Thoma–Jung's microtome is the best. The bits of tissue are fixed on pieces of cork which can be grasped by the clamp of the microtome. The specimens are easily fixed on the cork by means of a mixture of gelatine and glycerine prepared in the following manner: Dissolve 5 grammes of gelatine in 10 c. cm. of distilled water, and then add 20 c. cm of glycerine. A minute portion of this is melted by heat and placed on a smooth piece of cork of suitable size and shape; on this the piece of tissue, from which the superfluous alcohol has been sucked off by means of blotting paper, is placed and the cork is then put into absolute alcohol. The glycerine jelly becomes quite firm after being left for a few hours in alcohol. Where the tissues are friable they must be embedded in paraffin or celloidin, best in celloidin. The tissue after having been hardened in alcohol is placed for some hours in a mixture of alcohol and ether. It is then removed to a solution of celloidin in equal parts of alcohol and ether and left for some hours. It may then be fixed on a cork by means of celloidin or laid in a paper mould filled with celloidin. In either case the specimen with its coating of celloidin is placed in an eighty-two per cent. alcohol to harden and is then cut as before. After the sections are cut they are put into alcohol.

The methods of staining differ for different bacteria, but are very similar to those described under cover-glass preparations. Where sections are being examined for unknown bacteria, the best solution to

employ is probably Löffler's alkaline methylene-blue. The formula is:

100 c. cm. of a 1 to 10,000 solution of caustic potash.

30 c. cm. of a saturated alcoholic solution of methylene-blue.

The sections are left in this solution for from half an hour to an hour, and are then washed in distilled water or in dilute acetic acid (one-half per cent.). If they are washed in acetic acid they must again be put in water to remove all the acid. They are then placed in alcohol to remove the water, then in oil of cedar, in which they may be examined or from which they may be mounted in Canada balsam dissolved in xylol. Oil of cloves should be avoided in all cases, as it is apt to dissolve out the stain from the bacteria.

The original method introduced by Weigert and Koch was to stain in a saturated watery solution of fuchsin, gentian-violet, or methyl-violet, or in a solution made as before described by adding a saturated alcoholic solution to water. From this the sections were transferred to water and then, in order to have only nuclei and bacteria stained, to dilute acetic acid; afterward to water again, alcohol, oil of cedar, etc. The acetic acid is, however, very apt to remove the stain from the bacteria, and hence it has been found best to give up acetic acid and use alcohol for differentiating the nuclei and bacteria. Thus, after being washed in water, they are at once placed in alcohol.

It is better when employing these stains to use the solutions in aniline water, because a deeper stain is thus obtained, and also because more bacteria take on the stain than when the plain watery solutions are used. The best stain is the saturated solution of gentian-violet, fuchsin, etc., in aniline water. This stains in fifteen to thirty minutes and the sections may or may not be washed in dilute acetic acid.

In sections stained in this way a double stain may often be obtained. Sections stained in aniline gentian-violet and washed in alcohol may be placed for a short time in a dilute alcoholic solution of eosin, and then again washed in alcohol and placed in oil of cedar. The result is that the bacteria and nuclei are blue and the remainder of the section rose-colored. In the same way violet stained specimens may be placed in various carmine solutions (chiefly picrocarmine), when the nuclei come out red and the bacteria violet, or specimens colored red may be stained in hæmatoxylin. In these cases, however, it is best to employ Koch's method of obtaining isolated staining of the bacteria before staining in the contrast stain. This is done by placing the sections, after being stained, in a solution made of equal parts of a saturated solution of potassium carbonate and distilled water. They remain there five minutes and are then transferred to alcohol.

One of the most beautiful methods of staining is Gram's method, but, unfortunately, only a few bacteria stain in this way. The sections are

stained either in the Weigert–Ehrlich tubercle solution or in the saturated aniline solution of gentian-violet. Twenty to thirty minutes suffice. They are then at once placed in a solution of iodine (1 part of iodine, 2 parts of potassium iodide, and 200 parts of water) for five or fifteen minutes. Thence they are transferred directly to alcohol and left there till no more stain comes out. (It is frequently necessary to change the alcohol several times.) The result is that the section has a faint yellowish tinge while the bacteria appear of a blackish-blue color. These sections can then be double-stained by immersing them for a short time in a dilute solution of vesuvin, or, better, by placing them in a solution of picro-lithium carmine (1 part of lithium carmine and 3 parts of picric acid). In fact, the best way is to stain the sections first in picro-lithium carmine, then wash them in alcohol, and then stain with Gram's method; the nuclei and tissues retain the picrocarmine while the bacteria take on the gentian-violet. In this case care must be taken that the picrocarmine is fresh, for bacteria are very apt to grow in it, and, if that has occurred, when the specimen is afterward put in Gram's solution the bacteria adhering to it are stained, and mistakes are thus apt to occur. In staining with Gram's method the sections must not be put in water at all, and, indeed, it is important to remember in all these methods that it is best to put the sections straight from the alcohol in which they were first placed, after being cut, into the staining fluid and not to wash first in water.

Tubercle bacilli are stained in the same manner as described before under cover-glass preparations. The aniline fuchsin is the best solution to use, as the preparations are more permanent than those stained by gentian-violet. Various attempts have been made to get rid of the nitric acid, as it is apt to spoil the sections if they are very thin. In my paper on tubercle I suggested the following method: After staining the sections in Weigert-Ehrlich's fuchsin solution, wash in alcohol, and then place in the following:

Distilled water	100 c. cm.
Saturated alcoholic solution of methylene-blue . .	20 "
Formic acid	10 minims.

The sections are left for one or two hours in this solution and then washed in water, alcohol, etc. This method is not so certain as the older plan and, therefore, I only suggest its use for very delicate sections which are apt to be spoilt by the nitric acid.

Orth uses acidulated alcohol instead of nitric acid (one part of hydrochloric acid to 100 parts of 70 per cent. alcohol). Neelson employs dilute sulphuric acid as mentioned before. Other workers also employ acidulated alcohol. In fact, the acid is not absolutely necessary, for the contrast stain will ultimately replace the first stain in everything

but the tubercle bacilli if it only acts long enough; indeed this was what occurred in Koch's original plan with methylene-blue and vesuvin. Gibbes has suggested a double stain in which the bacilli become red and the tissues blue, but, unfortunately, this does not give thoroughly reliable results.

Leprosy bacilli stand midway between ordinary bacteria and tubercle bacilli in that they can be stained by the ordinary stains, more especially by methylene-blue, while they also have the same reactions as tubercle bacilli in resisting the nitric acid after staining with Weigert-Ehrlich's solution. In fact, this is the best way to stain them.

Lustgarten has described bacilli in sections of gummata and other syphilitic products which stain in a characteristic manner. His method is the following: the sections are stained in the Weigert-Ehrlich gentian-violet solution in the same manner as for tubercle bacilli. They are then placed for a few minutes in alcohol and then for ten seconds in a one and one-half per cent. watery solution of potassium permanganate From this they are transferred to a watery solution of pure sulphurous acid. The specimen becomes bleached in a few seconds. If it is not sufficiently bleached it is washed with water and put back in fresh permanganate solution for two or three seconds and then again into sulphurous acid. This is repeated till the specimen is completely bleached; it is then washed with water, alcohol, etc. The bacilli come out violet, the rest of the tissue is colorless. They differ from tubercle and leprosy bacilli, which are also stained by this method, in that the syphilis bacilli are decolorized by the nitric acid method. De Giacomi suggests the use, first, of a dilute, and then of a concentrated solution of ferric chloride instead of the potassium permanganate and the sulphurous acid. In the healthy smegma, Alvarez and Favel have also found bacilli which show the same reactions and are of similar appearance, and their statements have been confirmed by others.

Several other bacteria are difficult to stain, but the peculiarities of each kind will be referred to later. Typhoid bacilli are best stained with the alkaline methylene-blue, and so are the bacilli of glanders, which are very difficult to stain. The spirilla of relapsing fever stain in cover-glass preparations of blood with methyl-violet, fuchsin, etc., but in sections the best solution is a watery solution of vesuvin or Löffler's methylene-blue solution.

For fungi in the tissues the methylene-blue solution is the best. For actinomyces Weigert recommends a solution of orseille dissolved in a mixture of 20 c. cm. of absolute alcohol, 5 c. cm. of acetic acid, and 40 c. cm. of distilled water, till the fluid is dark red. The sections are stained in this for an hour, then washed in a one per cent. watery solution of gentian-violet, and afterward in alcohol, oil of cedar, etc.

The rays of the fungus are stained bright red and the nuclei of the tissue violet.

In examining stained specimens with the microscope the focussing of the light, the centring of the condenser, and the correction of the lens must be carried out as carefully as in the other case, but instead of a small diaphragm a large one or no diaphragm at all must be employed. The reason is this: in the unstained specimen one wants to see as much of the structure picture as possible and, therefore, light must be shut off; but in stained specimens the stained objects would only be obscured by the structure picture, whereas they are quite as easily recognizable in a flood of light, while the structure picture disappears. The only objections to the entire absence of a diaphragm are, first, that if the light is very intense it is painful to the eye, and secondly, that it is only a very good lens that can stand the complete absence of the diaphragm, for if the lens is imperfect the image appears blurred.

Before examining specimens mounted in balsam with an oil lens it is well to surround the margin of the cover-glass with some material impermeable to oil, such as shellac, and allow this to harden before use. Hence, the investigation of the specimen, in the first instance, is made with the specimens in oil of cedar, and only when it is desired to preserve the specimen is it mounted in Canada balsam.

INTESTINAL CONCRETIONS RESEMBLING SAND, AND ORIGINATING IN CELLS FROM THE BANANA.

By N. L. Bates, M.D.,
MEDICAL INSPECTOR U. S. N.

Obscure and puzzling cases may eventually prove to be unexpectedly plain. What has been done by one is liable to be repeated by others; hence the history of my cases and of the efforts made to ascertain the nature of the unknown substance which caused them may save time and trouble to some one who might otherwise become involved in a search similar to my own.

Four years ago I washed from the fecal movement of a child a half ounce or more of siliceous, organic cells, closely resembling in external appearances fine black sand. Since that time these cells have been examined by many of the ablest chemists, microscopists, and physicians of the country, who were unable to give any information as to their origin, or even to decide whether they belonged to animal or vegetable life. Twice I read articles on the subject before societies; in one instance before a large audience representing almost every branch of scientific

research. Specimens were shown, both in the natural state and with the microscope, but no one present identified them with any known cells. The specimens had been seen and examined by more than a hundred physicians and microscopists, when Dr. Robert T. Edes recognized them as probably of similar origin to those he had described in the Boston *Medical and Surgical Journal* of May 10, 1883, and which had been identified as coming from the banana. My cases are as follows:

CASE I.—Yokohama, Japan, July, 1882. Eva M., aged five years. Only child of American parents, both living; a pale, delicate-looking girl, sedate and precocious, with a history of indigestion, habitual constipation, and occasional attacks of gastric catarrh. The constipation and indigestion commenced when the child was two years of age, and were without apparent cause, but led to such care and watchfulness on the part of the mother and other members of the family that every minute detail of the child's life could be given.

On my first visit, the patient had fever, vomiting, gastric pain and tenderness, a tense, hard abdomen, and constipation. The bowels were relieved with great difficulty. Frequently repeated and large enemata were thrown well up the bowel, but the atony of the intestine was so great that the water was retained and oozed away on a folded sheet placed under the hips. I noticed one morning that this sheet was liberally sprinkled with a fine black sand; the mother said that these gritty particles came from the bowels, caused the child much uneasiness, and that she had folded the sheet differently several times on account of them. They were clean, and there was no appearance of fecal matter or discoloration on the sheet. I saved some of the deposit, and directed the mother to send me the first fecal movement, and as much of the sand as she could gather. Shortly after, the obstruction yielded to an enema containing one-half ounce fluid ext. of senna, and an enormous and very offensive fecal movement was obtained. The mother sent me only a small portion of it, from which I washed a tablespoonful or more of a substance closely resembling in general appearance fine black blotting sand. I am unable to state how much there was in all, but the mother of the child estimated the amount as two teacupfuls of sand in a chamberful of feces.

The relief was immediate, and practically the end of the case. A month later there was a lighter attack of similar character, but no obstruction in the intestine and only a small quantity of the black deposit. The child passed from under my care a few months later, returned to the United States, and died of diphtheria about two years afterward. Up to the time of her death there were no severe gastric or abdominal attacks, and although carefully looked for, no more black specks were ever seen. Had there been any, I am sure they would not have escaped recognition.

CASE II. occurred in Washington, November, 1885. This was the youngest of several children of parents both living, a girl, six years of age, with a pallid, muddy complexion, and a history of malaria, constipation, pasty clay-colored stools, and worms (?). There was a distended but tympanitic abdomen, pain in the left side just below the ribs, but no acute symptoms. The urine was normal, and no enlargement of liver or spleen was detected. It was only because I was attending another

child in the same family that my attention was called to this case. The mother stated that at frequent intervals, for two years, she had given the child santonin and castor oil for worms, and always with good effect. No worms had ever been seen, only "eggs and skins." I prescribed the same remedies, and requested that all the movements should be saved. The result was the same as on previous occasions, but the so-called worm skins were long strings and shreds of tough mucus, and the eggs, although in small quantity, at once recalled my Yokohama experience.

I have heard of three, perhaps four, similar cases; one in Japan, one in Washington, one in Ohio, and the fourth in Massachusetts. Of the first, Dr. Stuart Eldridge, of Yokohama, writes:

CASE III.—"The child was, in this case, though stout and fairly strong for its age, three years, and previously, according to the mother's account, perfectly healthy, of a pasty complexion, and for some days before I saw it troubled with colic-like pains, which were relieved by a stool, to recur spontaneously within twelve to twenty-four hours. I was sent for because the mother detected the abnormal particles in the stool; these were so plentiful in the specimen I examined as to form nearly one-fourth of the whole mass, the amount sent me being that of a good copious evacuation." "The grains were exactly like those" in the Eva M., Yokohama case. This case was not seen again, and no further history obtained.

CASE IV. is reported to me by Dr. C. H. H. Hall, U. S. Navy. His own child, a boy, three years of age, passed a half teaspoonful of black, sandy-looking grains after a dose of santonin and castor oil had been given—none had ever been seen before, and although looked for, none have been seen since. No examination was made, but in general appearance they resembled my specimens.

CASE V.—The clinical history is wanting. Prof. Romyn Hitchcock received some years ago, from a physician in Ohio, specimens which he is quite sure were the same as mine, but he does not now know who sent them nor the history of the case.

I have been promised the details of a case occurring in the practice of a physician in Salem, Mass., but have not received them.

In my cases the cells were of such peculiar character that identification would have seemed comparatively easy; yet it was in their most striking characteristics that they differ from the banana cells in their natural state, where they are white, translucent, and only resemble in size and form the objects from the intestine. If a transverse slice of banana is placed in a watch-glass and covered with strong nitric or sulphuric acid, a double row of cells, with a spiral fibre between, will become visible, enclosing three lobes in the centre of the slice, and the cells will eventually become of a garnet-red color. They are not so deep in color as my specimens, and have not the weight and resistance, but otherwise resemble them closely.

The cells from my Yokohama case could not be readily cut or crushed; were deep red-brown in color; had a sp. gr. 1.59; and contained four per cent. of silica. With the naked eye and sense of touch they could not have been distinguished from so much blotting sand. As passed from the bowel on the sheet they were perfectly clean, free from fecal or

other adherent matter, with nothing to give any clew to their origin, except size, form, and the manner in which they were joined together, and in none of them was there anything which could indicate a probable source. Their appearance under the microscope is well shown in the accompanying illustrations.

One of my patients, so the mother said, had never eaten fruit of any kind. In answer to a direct question, however, she admitted that the child had occasionally eaten a small piece of banana. The Yokohama child had eaten banana quite freely some months before I saw her; but, as the fact was not mentioned, and the fruit not at all common in Yokohama, I had no reason to suspect it. I examined the drinking water and all suspected foods, including native fruits and candies.

The Japanese persimmon was suggested as a probable source by a Japanese microscopist, but I did not find any cells in them like mine. I have recently thought, however, that treatment by nitric acid might develop them, and have requested a friend in Japan to make a thorough examination of the persimmon.

The banana may not be alone responsible for this black sand in the intestine, but with the recognition of one source, others may be more readily ascertained. The number of cases collected, and the clinical history of some of them, are enough to give these objects sufficient importance to be remembered.

A suspicion of entozoa was or might naturally have been entertained in most of the cases. So far as known, all the cases were children, and constipation was a prominent symptom. Some, but certainly not all, may have been constipated from birth, and had the elongated descending colon which Prof. Jacobi has noticed as a cause of constipation in infants.

Severi, Alberto (*Lo Sperimentale*, Firenze, 1884, xiii. 482–508) gives statistics of measurements of the large intestine in the fœtus and in children. From the seventh month of fetal life to the end of the second year of child life, the length of the large intestine exceeds the length of the child. With increased age and growth the excess is lost, and finally disappears. It may be that the more numerous folds and flexures of the large intestine of the child favor the accumulation of these objects, and that the intestine in later life is not adapted to their retention.

At all events, I am disposed to regard a prolonged stay in the intestines as necessary for the development of the deep color; hard, sharp, and gritty character; high specific gravity, and siliceous contents of these cells; and when thus developed, they are no more innocent than would be a corresponding quantity of sharp sand.

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THE ACTION OF SULPHURIC ETHER ON THE PERIPHERAL NERVOUS SYSTEM.

FROM EXPERIMENTS PERFORMED IN THE PHYSIOLOGICAL LABORATORY OF THE HARVARD MEDICAL SCHOOL, BY DR. F. H. HOOOPER, DR. F. W. ELLIS, AND MR. J. W. PERKINS.

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In an article on "The Respiratory Function of the Human Larynx" in the *N. Y. Medical Journal* for July 4, 1885, Dr. F. H. Hooper recorded the observation that stimulation of the recurrent laryngeal nerves of

dogs causes a dilatation of the glottis when the animals are thoroughly etherized, but a constriction when they are slightly or not at all under the influence of the drug. As the phenomenon occurred equally well whether the stimulation was applied to the intact nerve or to its peripheral end after section it was evident that the action of the drug must be either upon the peripheral portions of the nerve or upon the muscles.

In order to decide between these alternatives, and to ascertain whether similar observations could be made upon other groups of antagonistic muscles supplied by a single nerve trunk, experiments were undertaken by Mr. J. W. Perkins, interne at the Children's Hospital, Boston, in the autumn of 1885.

The sciatic nerve of the frog, with the groups of flexor and extensor muscles which it supplies, was selected for purposes of experiment. The frog was prepared by destroying the medulla and cord. The sciatic plexus was dissected out on both sides and shielded electrodes placed on the nerves close to their origin from the cord. The frog was then suspended in such a way that the hind legs hung freely in fluid contained in two beaker glasses, one leg being immersed in a 0.5 per cent. solution of common salt and the other in a similar solution to which three per cent. of sulphuric ether had been added.

Tetanic stimulation of the sciatic plexus was produced by a Du Bois Reymond induction apparatus having a secondary coil consisting of 10,260 turns of fine wire and graduated with arbitrary units of intensity such that the maximum stimulation, produced by pushing the secondary completely over the primary coil, corresponded to 1000 units of intensity.

The experiment consisted in applying, at short intervals, a tetanic stimulation of very weak intensity ($I = 0.5 - 2$) to each sciatic plexus in turn and observing the position of the legs as one of them gradually came under the influence of the ether. It was observed that at the beginning of the experiment stimulation produced the same effect on both sides; viz., extension of the leg and abduction of the toes. After the ether had been applied five or ten minutes this effect gave place to a flexion of the leg and adduction of the toes, and after about twenty minutes the stimulation failed to produce any effect. Stimulation of the nerve on the side where the leg was immersed in the salt solution produced the same extension as in the beginning of the experiment. The solutions were now interchanged so that the etherized leg was suspended in the salt solution, and *vice versâ*. As the effect of the ether disappeared from the leg in the salt solution the stimulation of the nerve produced at first flexion and adduction which afterward gave place to extension and abduction as at first. This experiment was repeated with very constant results upon five different frogs.

It thus appears that there is a stage in ether narcosis when stimulation of the nerve, which ordinarily produces extension and abduction,

causes the opposite effects and this action can be observed both when the narcosis is coming on and when it is passing off. For the sake of brevity, this action of ether will be termed the "ether effect." The phenomenon is apparently the same as that observed by Hooper on the larynx and, so far as the physiological action of ether is concerned, the constrictors of the larynx seem to correspond to the extensors, and the dilators of the larynx to the flexors of the leg, an analogy the reverse of that which was maintained by Rosenbach,[1] who was led to his conclusions by pathological considerations.

Since in these experiments the central nervous system was destroyed, it is obvious that this "ether effect" must be at the periphery, but whether upon the nerve trunks, the nerve terminations, or the muscular fibres cannot be decided from the above experiments.

To study this question the following experiment was performed. The sciatic nerve was freed from its connections for a distance sufficient to permit the portion of the nerve between the electrodes and the muscles to be immersed in a solution of ether. This was most readily effected by means of a bent glass tube, with a hole blown in the side, such as is represented in Fig. 1. The tube was bent or inclined at such an angle that fluid introduced by means of a pipette into the upper end would flow down and cover a loop of the nerve and could at the same time be readily washed away and replaced by another fluid introduced in the same way. Five experiments performed in this way gave results which were very constant and quite similar to those obtained when the ether was applied to the skin of the leg. The only important difference was that the action of the ether was much more prompt when applied directly to the nerve, complete paralysis taking place in about seven minutes. The "ether effect" manifested itself both in flexion and adduction and occasionally in peculiar twisting movements of the phalanges due to unequal stimulation of the various muscles. The important observation was also made that whenever flexion was obtained it could be converted into extension *by increasing the intensity* of the stimulation.

FIG. 1.

From these experiments we are justified in concluding that the "ether effect" is a phenomenon dependent upon the action of the drug upon

[1] Bresl. ärztl. Zeitschr., 1880, Nos. 2 and 3.

the nerve fibres themselves, though, of course, the possibility of a simultaneous action upon the muscles is not excluded. An attempt was made to ascertain whether any such action of the drug upon the muscles really occurs by poisoning a frog with curare and applying electricity directly to the limb while immersed in a solution of ether.

It was found, however, to be practically impossible to apply the electricity in such a way as to stimulate uniformly all the muscles of the limb and thus produce a movement comparable with that obtained when the muscles are stimulated through the nerve. The experiments made in this way were, therefore, inconclusive. It is evident, however, that the observed action of ether on the nerve trunks is sufficient to explain the "ether effect," and since, when one sufficient cause is demonstrated, it is illogical to assume the existence of another, we may conclude for the present that the phenomenon in question concerns exclusively the nerve fibres.

We must next inquire whether the ether can be supposed to exercise an elective action upon the fibres contained in the nerve trunk and to paralyze the fibres supplying the extensor and abductor muscles before it affects those which go to the flexor and adductor group, or whether some simpler and more probable explanation can be suggested.

The above-mentioned observation that flexion could be converted into extension by increasing the intensity of the stimulation, suggests the idea that the "ether effect" may be simply *partial paralysis* of the nerve fibres. On this hypothesis we should expect to find that stimulation of the nerve with a *very weak* current would cause flexion of the limb, even without the application of ether.

To test this question and also to study the effect of various other reagents besides ether upon the nerve trunk, a series of experiments on frogs were undertaken in the spring of 1886, by Dr. F. W. Ellis.

In these experiments the frog was prepared in the same way as by Perkins, but the position of the legs resulting from the stimulation of the nerve was recorded by means of photography. For this purpose the legs of the animal were suspended in water contained in a large cell with parallel plate glass sides. Behind the cell a piece of opaque white glass afforded a suitable background and in front was placed a dry plate camera by means of which the position of the legs could be photographed instantaneously. The drugs used were mixed with one-half per cent. solution of sodium chloride in distilled water and applied to the nerve in the manner above described.

The ordinary effect of an electrical stimulation of the sciatic nerve is well shown in Fig. 2.[1] Even with quite weak currents there is ordinarily

[1] This and the following figures are photoelectrotype reproductions of photographs taken in the manner above described. As the frogs were suspended with their ventral surface toward the camera the right leg of the animal appears on the left of the figure, and *vice versâ*.

marked extension of the knee, ankle, and toes, accompanied by strong abduction of the toes. In other words, the position of the leg is that assumed when the animal is just completing a vigorous stroke in swimming.

FIG. 2.

EFFECTS OF ETHER.—In the experiments with ether, solutions of the drug varying in strength from one-half to five per cent., were employed. A three per cent. solution was most frequently used and gave, upon the whole, the best results. The observations of Perkins were in the main confirmed—*i. e.*, there was found to be a stage in the paralyzing action of the drug when stimulation of the nerve caused the leg to assume a position contrary to that occasioned by the same degree of simulation without ether. Instead of extension at the knee and ankle, there might be flexion; instead of extension and abduction of the toes, there might be flexion or adduction, or both. It was rare that all these contrary effects were manifested at once. There was generally a predominance of one, and frequently only one was manifested. These "ether effects" were obtained with some frogs more easily than with others, and were not always constant for the same frog. They were generally better obtained when the nerve was recovering from the effects of ether (*i. e.*, after removal of the ether solution from the tube and washing the nerve with saline solution) than when it was coming under the influence of the drug.

FIG. 3.

Ether on nerve.

FIG. 4.

Ether removed.

Figs. 3–8 illustrate these "ether effects." Fig. 3 shows the position assumed by the left leg on irritation of the sciatic nerve during the local application of ether. Fig. 4, the position assumed by the same leg after the removal of the ether. Here flexion and adduction under ether gave place to extension and abduction on removal of the drug. Figs. 5 and 6

show a similar "ether effect" on the right leg, but confined in this case to the muscles moving the toes.

FIG. 5.

Ether on nerve.

FIG. 6.

Ether removed.

In Figs. 7 and 8 the "ether effect" manifests itself in a flexion of the foot and adduction of the toes combined with a strong extension of the leg.

FIG. 7.

Ether on nerve.

FIG. 8.

Ether removed.

The local application of ether to the nerve was found not to affect the irritability of the nerve below the point of application. This was shown by experiments in which electrodes were placed upon the nerve, both above and below the ether tube. When powerful stimulation applied above the tube no longer caused contraction of the muscles, a very slight current applied below would produce the usual effect. The ether, therefore, seemed to produce a change in the nerve at the point of application, which rendered it incapable of transmitting the ordinary nerve impulse, complete paralysis resulting when the action of the drug was pushed to its extreme, and the so-called "ether effects" during intermediate stages.

Experiments with chloroform and alcohol showed that the "ether effects" could be obtained with these drugs also, although not so strik-

ingly as with ether. A full discussion of the action of these and other drugs will be given on a future occasion.

It was also found, as had been previously observed by Perkins, that an increase in the intensity of the stimulation caused the "ether effect" to disappear, and the ordinary effect of nerve irritation (viz., extension and abduction) to take its place. This led to experiments on the effect of variation in the intensity of the stimulus, and particularly on the

Effects of very Weak Currents.—The first experiments showing the effect of very weak stimulation were accidental. It was noticed occasionally, when the right sciatic plexus was very strongly stimulated in order to ascertain whether the application of ether to the nerve of that side had produced complete paralysis, that movements of flexion were produced in the leg of the opposite side. These were obviously due to the escape of electricity upon the left plexus, and it was observed that a still further increase in the intensity of the stimulus applied to the right plexus caused the ordinary movements of extension and abduction on the left side. It was subsequently found that by employing weak currents it was generally possible to cause movements (viz., flexion and adduction), which were ordinarily excited by very much stronger stimuli after the application of ether to the nerve. To produce these effects, it was necessary to use currents of very feeble intensity. These were best obtained by separating the secondary coil of the induction apparatus

Fig. 9.

Weak irritation.

Fig. 10.

Strong irritation.

forty or fifty centimetres from the primary, and then turning it round a vertical axis. When flexion and adduction had been obtained in this way it was always possible to produce the ordinary movements of extension and abduction by increasing the intensity of the stimulation. Occasionally, as a result of very weak stimulation, twitchings or clonic contractions of the muscles were produced. These seemed to be due to a conflict between opposing sets of muscles.

Figs. 9–13 illustrate the effects of variations in the intensity of the

stimulation applied to unetherized nerves. Fig. 9 shows the position assumed by the left leg under the influence of a very feeble stimulus applied to the sciatic nerve of that side, and Fig. 10 the effect of a stronger stimulus applied to the same nerve.

FIG. 11.

Weak irritation.

FIG. 12.

Strong irritation.

Figs. 11 and 12 show, in a similar manner, the effect of increasing the intensity of the stimulus applied to the right sciatic nerve. Fig. 13 shows the effect of a weak irritation of the left sciatic nerve, and by comparing the position of the left leg in this figure with that of the right leg in Fig. 2, a good idea can be obtained of the great variety of movement which can be produced by changes in the intensity of the stimulation.

FIG. 13.

Weak irritation.

These experiments by Ellis prove beyond a doubt that the effects observed by Perkins on stimulating a nerve immersed in a solution of ether, can be obtained with other drugs, and often with very weak currents without any drug. Without ether, flexion and adduction are to be obtained only with very feeble currents, but with ether much stronger stimulation produces the same effect. In both cases, however, an increase in the intensity of the stimulus causes these movements to give place to extension and abduction; the effect of the ether may, therefore, be said to consist in transferring the point, on the scale of intensity, at which the effect of nerve irritation changes from flexion and adduction to extension and abduction from the region of weak to that of relatively strong stimulation.

The "ether effect," as observed in the sciatic nerve of the frog, may be best explained by supposing that a partial paralysis of the nerve by the drug converts what would naturally be a strong into a weak irritation, and that this weak irritation affects only the flexor group of mus-

cles because these are, for some reason or other, more irritable than their antagonists. A stronger irritation or a removal of the ether causes extension, since when both flexors and extensors are stimulated, the position of the leg is determined by the latter—*i. e.*, the more powerful group.

The question of the difference in irritability of the flexors and extensors of the frog's leg and the cause thereof has been much discussed. The fact that a feeble irritation of the sciatic causes flexion, and a strong irritation extension of the leg was first observed by Ritter in 1798, but the subject was first thoroughly investigated by Rollett in 1874–75.[1] This observer experimented with the amputated leg suspended in the air, and also with the muscles attached to myographic levers, and reached the conclusion that the cause of the greater irritability of the flexors was to be sought in the nerve fibres or in their mode of attachment to the muscles. Bour,[2] also, while criticising some of Rollett's methods, found that when the irritation was applied to the upper portion of the sciatic nerve, the flexors were called into action by a feebler stimulus than the extensors.[3]

There seems, therefore, to be no doubt that the flexor apparatus of the frog's leg responds to a feebler simulation than the extensor, but whether the cause of this difference lies in the nerve fibres, the muscle fibres, or in the mode of connection between the two, must be left for future investigations to determine. It is not impossible that the microscope may reveal histological differences between the different sorts of muscles similar to those described by Ranvier and others between the red and white muscles of the rabbit.

We must now inquire whether the above explanation of the "ether effect," as studied on the sciatic nerve of the frog, is applicable to the action of the drug, as observed by Hooper, on the recurrent laryngeal nerve of the dog.

A single observation upon a chloralized dog is reported by Hooper, in which a thread passed through the nerve and left in position for several days produced an effect analogous to that of ether on the sciatic nerve of the frog, viz., abduction of the vocal cord on irritation of the nerve on the side thus operated upon, while the same irritation on the opposite side produced the ordinary effect, viz., adduction. As all attempts to repeat this observation failed, no importance can be attached to it. On the other hand, it had never been observed in Hooper's ex-

[1] Sitzungsberichte der Wiener Acad. Dritte Abth., lxx. S. 7; lxxi. S. 33; lxxii. S. 349.

[2] Verhandl. d. Phys. med. Gesells. in Würzburg. N. F. viii. 221.

[3] Dr. W. P. Lombard has kindly made a few experiments upon the irritability of the muscles moving the knee-joint of the frog, using for the purpose the delicate apparatus employed by him in studying the reflex actions of the frog (Archiv für Physiologie, 1885, p. 406). These experiments, though interesting in themselves, are not conclusive as to the relative irritability of the flexor and extensor groups of muscles. The evidence, however, seems to be slightly in favor of the above mentioned conclusion of Bour.

periments that feeble irritations caused a dilatation of the glottis, while stronger ones caused a constriction, but, as the effect of *very feeble* stimuli had not been specially studied, it was thought desirable, in view of the positive results obtained by Ellis on the frog, to make a few additional experiments directed to this particular point. Experiments were accordingly made upon chloralized dogs, with the result of showing that feeble irritations differed from strong ones in the extent but not in the character of the movements produced. Nothing resembling a dilatation of the glottis could be produced by diminishing the intensity of the stimulus.

When this point had been reached in the study of the question, a paper entitled "The Function of the Recurrent Laryngeal Nerve," by F. Donaldson, Jr., B.A., M.D., appeared in *The American Journal of the Medical Sciences* for July, 1886. In this paper the writer gave an account of experiments on dogs similar to those made by Hooper, but leading to different results, for Donaldson, though unable to obtain the above described "ether effect," did observe a dilatation of the glottis when the recurrent nerve was irritated with *very weak* stimuli. This observation is, therefore, precisely in harmony with Ellis's results obtained upon frogs, and if confirmed would lead to the conclusion that the "ether effect" is in these cases also an effect of partial paralysis.

Shortly after the appearance of Donaldson's article a paper was read at the meeting of the British Medical Association in Brighton, entitled "On an Apparently Peripheral Differential Action of Ether upon the Laryngeal Muscles," by Felix Semon, M.D., F.R.C.P., and Victor Horsley, B.S., F.R.S. The authors were able to confirm the results of Hooper's experiments as to the effect of ether on the recurrent laryngeal nerve, and even gave a graphic representation of the "ether effect" studied by means of a rubber bulb inserted between the vocal cords. They explained Donaldson's failure to obtain the "ether effect" on the supposition that the animal was not sufficiently etherized. They also repeated Donaldson's experiments with currents of varying strength and obtained similar results in those cases in which the animal was not deeply under the influence of ether.

In view of these somewhat discordant results a renewed investigation of the effect of electrical irritation of the recurrent laryngeal nerve, with and without narcotics, seemed desirable, and Dr. Hooper is now engaged in a series of experiments which it is hoped will shed further light upon the subject.

The detailed results of these experiments will be published on some future occasion, but at the present time the following preliminary statement may be made.

It has not been found possible in these experiments to obtain a dila-

tation of the glottis by any stimulation of the recurrent laryngeal nerve unless the animal is under ether.

When the animal is etherized, the effect of irritating the nerve varies with the depth of the narcosis and the strength of the irritation.

If the animal is thoroughly under the influence of the drug dilatation of the glottis is produced by irritations of all intensities. In less profound etherization dilatation is still obtained with feeble irritation, but gives place to constriction when a stronger stimulus is applied.[1] As the effect of the ether passes off constriction occurs with feebler and feebler intensities until, finally, dilatation can no longer be obtained, and constriction is produced by irritation of all intensities.

The observation of Donaldson that dilatation is produced by feeble and constriction by strong stimuli is, therefore, correct *for a certain stage of etherization*, but for *unetherized* animals his statement has not been confirmed. The cases in which Donaldson has recorded a dilatation as a result of feeble stimulation are those in which the animal had been previously etherized, but was supposed to have recovered from the influence of the drug. In view of Hooper's failure to obtain dilatation on unetherized dogs, it seems probable that in Donaldson's cases the drug had not been completely eliminated.

It will thus be seen that, while the "ether effect," as shown on the sciatic nerve of the frog, may be explained as a partial paralysis of the nerve by the drug, the same explanation cannot be given of the phenomenon as manifested on the recurrent laryngeal nerve of the dog, for the action of ether cannot be imitated by feeble irritation of the nerves of unetherized animals.

The local action of ether, applied directly to the nerve, presents another point in which the two phenomena differ from each other, for the distinct "ether effects" obtained in this way by Perkins and Ellis on the frog's sciatic do not manifest themselves on the laryngeal nerve of the dog. A six per cent. solution of ether dropped upon the nerve of chloralized dogs, between the electrodes and the larynx, was found to gradually paralyze the nerve, so that stronger and stronger stimuli were needed to constrict the glottis, but a dilatation was, under these circumstances, never observed.

Conclusions.—The principal results of these various researches may be summarized as follows:

1. The ordinary effect of electrical stimulation of the recurrent laryngeal nerves of dogs is to cause constriction of the glottis, but if the animal is thoroughly etherized dilatation may be produced.

2. If the animal is partially etherized, the effect of the stimulation

[1] It will be observed that this result is in harmony with the above-mentioned observations of Semon and Horsley.

will vary with the strength of the current, a weak irritation causing dilatation, and a stronger irritation causing constriction of the glottis.

3. The more complete the etherization the greater is the intensity of the current necessary to produce constriction.

4. A similar "ether effect" may be observed when the sciatic nerve of the frog is stimulated, the ordinary extension of the leg and abduction of the toes giving place, under the influence of this drug, to flexion and adduction. It is, however, always possible to produce the ordinary effects by increasing the intensity of the stimulation; and, on the other hand, it is possible, by using very feeble stimuli, to produce without etherization the same effects which occur on the application of stronger stimuli to animals under the influence of the drug.

5. This "ether effect" on frogs may be observed both when the ether solution is introduced by cutaneous absorption, and when it is applied locally to the nerve below the point of stimulation. Hence the most reasonable explanation of the phenomenon is that the drug, by diminishing the conducting power of the nerve, causes a strong irritation applied to the nerve to become a weak irritation when it reaches the muscles.

6. This explanation cannot be applied to the phenomenon as exhibited by the recurrent laryngeal nerve of the dog, for without ether feeble irritations do not produce dilatation, and, with complete etherization, strong stimuli do not produce constriction of the glottis.

COCAINE, AND ITS EMPLOYMENT IN OPHTHALMIC SURGERY.

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Since the invention of the ophthalmoscope in 1851, no discovery has been made which is likely to have so great an effect upon the progress of ophthalmic surgery as that of the anæsthetic effect of cocaine upon the eye. By doing away with the necessity of general anæsthesia, cocaine has robbed ophthalmic operations of their chief element of fear, so far as the patient is concerned, and has, at the same time, relieved the surgeon of a frequent cause of anxiety, both at the time of the operation and subsequently. As a consequence of this, not only have many operative proceedings and modes of treatment, which formerly were only occasionally resorted to on account of the pain or inconvenience attending them, become matters of daily practice, but an impetus has been given to the introduction of new modes of treatment, operative and otherwise.

In this respect the introduction of cocaine will have an effect upon

ophthalmic surgery analogous to that which the introduction of general anæsthesia had upon general surgery, leading, as did the latter, to the substitution of frequent minor operations having a conservative tendency for the rarer and more radical ones. The introduction of anæsthetics, however, tended rather to discourage celerity in operating, while the employment of cocaine will have an opposite tendency.

It is early yet to see much effect in the direction of the introduction of new proceedings, the attention of the ophthalmic surgeon having been concentrated on discovering how its use affected those already well established. But already the signs of the coming change are visible. Paracentesis of the anterior chamber in iritis, the scraping away of old corneal opacities, the treatment of some forms of ulceration by the actual and potential cautery, and the cutting short of acute conjunctivitis by the application of strong astringents, are none of them new proceedings, but they were all of them sufficiently formidable to render their adoption exceptional, whereas they can now be employed in the ordinary routine of practice.

The alkaloid appears to have been first separated by Nieman[1] as long ago as 1859. Its physiological effects, when administered internally, were fully investigated by Hughes Bennett in 1873.[2] Its anæsthetic effect upon the mucous membrane of the tongue when applied locally had already been noticed by Schroff in 1862, in a communication which he made to the Medical Society of Vienna, but it does not seem to have occurred to anyone at that time that its anæsthetic properties could be turned to any account. The first suggestion to this effect appears to have been made by von Anrep, in 1880,[3] who experimented both by means of subcutaneous injection and by applications to the tongue. To Koller,[4] of Vienna, is, however, certainly due the credit of having first made definite experiments with the view of ascertaining whether the alkaloid had the same effect on the ocular as on the buccal mucous membrane. And it is to the result of these experiments that we are indebted for its introduction into practice.

The plant from which the alkaloid is obtained—the erythroxylon coca—is a native of South America, and there is a plentiful supply of the leaves, but the quantity which can be extracted from them is very small, being only one-fifth per cent. from the best. The following is said to be the best mode of separating the alkaloid:[5] Digest the leaves (the smallest being the best) within distilled water at a temperature of 60°–80° C., filter, and precipitate with acetate of lead. The excess of lead is removed with sulphate of soda and the filtrate is shaken up with ether. To clarify it water and hypochloric acid are added; it is then filtered, precipitated by carbonate of soda and crystallized out with hot alcohol. The alkaloid is soluble in alcohol, chloroform, and ether.

Cocaine was not appreciated in England quite as soon as in America;

this was partly due to the statements with regard to its anæsthetic effects having been received at first with some incredulity, and partly to the great difficulty which was at first experienced in obtaining a supply. Dr. Benson was one of the first to employ it, he having obtained some from America through a private source, but his first experiments do not seem to have impressed him very favorably for, in his first communication to the Ophthalmological Society,[6] he only hinted doubtfully that it might prove useful in some minor ophthalmic operations. Shortly afterward, however, it was freely used in all directions, and it was soon found that a discovery of the very first importance had been made.

We propose to consider: First, its physiological effect when applied to the eye. Second, its employment in ophthalmic surgery. Third, some occasional injurious effects.

Physiological Effect.[7]—(*a*) Applied to the eye it produces mydriasis, but this differs in several respects from that due to atropia.

The actual dilatation is often greater, although this is very variable, but the activity of the pupil to variations of light is retained. When as great a dilatation as possible has been produced by a single instillation of atropine, cocaine will increase it; the mydriasis from cocaine alone, on the other hand, is not increased by atropine. The excess of mydriasis produced by the cocaine is subject to the influence of light. By repeated instillations of atropine, however, a full mydriasis can be obtained which cannot be increased by cocaine.

The mydriatic effect, however, is extremely weak, for if equal proportions of eserine and cocaine be employed the mydriasis does not differ from that produced by eserine alone. In order that the two drugs should neutralize each other it is necessary that twenty-five parts of cocaine should be employed to one of eserine.

The mydriasis which follows paralysis of the third nerve is further increased by cocaine. When in rabbits the cervical sympathetic has been divided cocaine applied to the eye ceases to have any effect upon the pupil. In a patient of Jessop's who had all the symptoms of paralysis of the cervical sympathetic, repeated instillations of cocaine had no effect upon the pupil, but homatropine acted in the usual way.

When cocaine is applied to only one part of the cornea, the mydriasis is sometimes partial, affecting only the corresponding portion of the iris.

A drug may produce mydriasis by paralyzing the sphincter or the nerves supplying it, or by irritating the dilator fibres or their nerves. That cocaine does not act by paralyzing the sphincter or the branches of the third nerve which supply it, is evident from the retention of its contractility to light, and from the action of cocaine when the third nerve is paralyzed. It does not act directly upon the muscular fibres, or the sphincter, which is the stronger, would predominate. We are driven, therefore, to the conclusion that it acts upon the dilator fibres

of the sympathetic, and its inactivity when the sympathetic has been divided is consistent with this.

Additional proof that the action on the iris occurs through the medium of the sympathetic is afforded by the results of Pflüger's experiments on birds.[27] In these the sympathetic nerve supplies the bloodvessels of the iris but not the dilator fibres, the latter receiving a special branch from the trigeminus. When the cervical sympathetic is divided above the superior cervical ganglion there is increased vascularity of the conjunctiva but no alteration in the pupil; and cocaine has no effect upon the pupil in birds, although it acts as an anæsthetic.

Cocaine mydriasis passes off in less than twenty-four hours. According to Jessop the dilatation of the pupil is very great and is quickly produced. According to the writer's experience, however, the action of cocaine varies very much in this respect in different individuals, and without corresponding variations in its anæsthetic effect. Occasionally he has seen complete anæsthesia produced with hardly any dilatation of the pupil; this, although exceptional, was not more so than full mydriasis.

(*b*) Another noticeable effect of cocaine is the widening of the palpebral fissure, this is due to retraction of both lids, but the effect is usually more marked in the upper. Jessop found that it still occurred if the orbicularis was paralyzed; it can, therefore, only be due to contraction of the involuntary fibre muscles of Müller, which are supplied by the sympathetic.

(*c*) Cocaine also causes contraction of bloodvessels, as might be expected from its action upon other sympathetic nerves: as the result of this there is often marked anæmia of the conjunctiva, and probably the great diminution in the amount of lachrymal secretion is due to the same cause. Upon vessels that are dilated from inflammation, however, it has little or no effect; probably this is because the power of the muscular coat of the bloodvessels is mechanically interfered with when the dilatation is excessive.

(*d*) The lowering of the intraocular tension, and the consequent flaccidity of the cornea which occurs in the cocainized eye is probably due to the contraction of the bloodvessels causing diminished intraocular secretion. There is reason to believe that at the same time the lymph spaces of the cornea contain less fluid, and its absorbent power is consequently increased; this will be referred to again in considering the occasionally injurious effect of cocaine.

(*e*) From a practical point of view the anæsthetic effect is, of course, the most important. There can be no doubt that it acts directly upon the nerve terminations, and is not due, as formerly supposed by Everbusch,[8] to the contraction of the arterioles, and resulting anemia. This is evident from the following facts: its action is very local, it acts with equal efficacy upon vascular and non-vascular structures, its anæsthetic

effect upon non-inflamed eyes does not vary with the anæmia produced, and the rapidity with which different structures are affected varies with the ease with which the cocaine reaches them. The sensibility of the conjunctiva and cornea are lost first, that of the iris not till the drug has reached the aqueous. As the result of numerous experiments in squint operations the writer has come to the conclusion that cocaine dropped upon the conjunctiva has little or no effect upon the sensibility of the muscles, but that it acts well and quickly if injected subconjunctivally.

Dr. Howe[9] has made some very ingenious and instructive experiments with the view of measuring and expressing numerically the anæsthesia produced. The basis of these is the well-known fact that the irritation of a sensory nerve causes a rise of blood-pressure throughout the body. A rabbit is taken and curarized to eliminate muscular contraction, which would otherwise influence the blood-pressure, and artificial respiration is carried on by means of a special apparatus, which insures its rhythmical performance, and whose effect upon the blood-pressure is a constant factor. A mercurial kymograph provided with a self-recording apparatus is then connected with the crural artery. A tracing is first taken to find the normal blood-pressure, which shows rhythmical variations corresponding to the heart's action. One eye having been cocainized, irritants of various kinds are applied successively to both, and the differences in the effect upon the blood-pressure noted.

The minimum dose required to produce any anæsthetic effect in the rabbit was a single drop of a 0.04 per cent. solution. The maximum effect of a 2 per cent. solution was attained on an average after a quarter of an hour and was as great as that of a 5 per cent. solution.

These experiments do not pretend to be exhaustive, but they open up a new field for investigating the action of cocaine; unfortunately this is forbidden ground to most in England.

The anæsthetic effect of cocaine upon eyes of which the deeper tissues are inflamed is very slight, probably this is in part because absorption in such is slow, and in part because there is hyperæsthesia. Often, however, it produces a marked effect in conjunctival inflammation when the photophobia is excessive as compared with the hyperæmia, the condition so often seen in the commencing catarrhal ophthalmia in young children. In such the writer has found that cocaine has immensely facilitated the examination of the eye.

Clinical Uses.—Incidentally several of the conditions under which cocaine can be utilized have been mentioned, and others can be inferred from what has been said. Broadly speaking, one may say that it will produce sufficient anæsthesia for any operation, when it can be brought into contact directly or by absorption with the parts implicated. The fact that the iris retains its sensibility longer than the cornea, has led to the suggestion that it should be injected into the anterior chamber either

at the commencement of the operation, or after the corneal incision has been made. There are, however, obvious objections to this, and quite sufficient anæsthesia of the iris is produced by repeated instillation into the conjunctival sac. A local anæsthetic would be extremely useful for squint operations, since the retention of muscular contractility is of great assistance in guaging the effect produced. The writer has, however, found cocaine extremely uncertain in its action in these cases. When injected beneath the conjunctiva it acts well and promptly, but the chemosis which is produced is a decided inconvenience.

The use of cocaine, however, in ordinary ophthalmic operations is so general, and experience as to the immense advantages it possesses is so uniform, that it will be better to pass at once to the consideration of its employment in ways which are less generally practised, and to discuss in what direction practice is likely to be influenced by its introduction.

The treatment of ulcers of the cornea is likely to be modified in several respects. In the recurrent vascular ulcer, in which a single leash of vessels runs up to the ulcer the writer has found much good follow from the division of the vessels,—a proceeding which is not new, but one which could only be practised in exceptional cases when general anæsthesia was necessary. Mr. Carter's suggestion[10] also of treating some forms of ulcer by the application of nitrate of silver is an extremely valuable one if care be taken that the application is strictly localized. Cocaine renders this easy by preventing the reflex lachrymation, and at the same time putting the eye completely under control. Lately the writer in cases of pannus in which the vessels are not too numerous, has adopted the plan of obliterating the several vessels, but touching them just beyond the corneal margin with a very fine point of nitrate of silver, and has so far been well satisfied with the results. Paracentesis for pain in iritis is another instance of most successful practice, which has been rendered easy.

It remains to be seen how far the property which cocaine possesses of lowering tension can be utilized. Hitherto it has not been used in glaucoma except in conjunction with eserine; indeed, its mydriatic effect would probably counteract any beneficial effect that it might otherwise have, and as the eserine has always been used in quantities more than sufficient to counterbalance the merely mydriatic effect of the cocaine, it is impossible to say how much effect the cocaine had upon the tension.

In iritis the combination of cocaine and atropine has been extensively used, and, it is thought, with good results. Jessop has shown that these drugs together produce full mydriasis in the normal eye, more quickly than either of them alone. The dilating power of the cocaine is, however, so feeble that it is doubtful whether it can assist much in overcoming an adhesion.

In the cases of irritable conjunctiva in which there is excessive lachry-

mation of the eyes on exposure to cold, wind, etc., without any obvious cause to account for the symptoms, the writer has attempted to turn to account the power which cocaine possesses of diminishing secretion; but although the trouble diminishes while the cocaine is being used, he has not seen any permanent relief produced.

INJURIOUS EFFECTS.—That so potent a drug should occasionally produce injurious effects is no matter of surprise, and numerous instances have now been recorded in which cocaine applied to the eye, or injected, has been followed by local lesions, and by general toxic symptoms. Some of these are, no doubt, to be explained by impurities in the drug, an excessive and unnecessary concentration of the solution employed, and individual idiosyncrasies; deducting these, however, there still remains a residuum of cases in which cocaine undoubtedly produced bad local or general effects.

In almost the first case in which the writer used cocaine, the patient —a lad of fourteen—turned pale, and broke out in a profuse perspiration, a few minutes after the instillation of a single drop of a four per cent. solution, the pulse became very small and slow, and the lips bluish. Ammonia was administered and the patient made to lie down, but it was nearly an hour before he recovered from the condition of partial syncope. These symptoms might have been due to fright, but the patient did not show any signs of nervousness. In another case[11] the instillation of about fifteen drops of a two per cent. solution in a girl of twelve, was followed by severe pain in the head, dryness of the throat, marked malaise, tottering gait, and a difficulty in speaking as if the tongue were paralyzed. The symptoms lasted thirty hours.

The majority of the cases, however, have been elderly people, generally badly nourished. In three cases recorded by Bellarminoff,[12] vomiting persisted for several hours.

In the following case the repetition of the symptoms each time that the cocaine was used, leaves no room for doubt that they were really due to it.

In a woman,[13] aged seventy, with pulmonary emphysema, six to eight minims of a two per cent. solution were instilled, and cataract extraction performed; delirium came on which lasted for several days. A discission was performed eight days later for which three drops were instilled; great dyspnœa followed: this may, however, have been due to the previous condition of the lungs. On the following day six minims were instilled (for what purpose is not stated): dyspnœa, vomiting, and complete loss of appetite followed. Finally, cocaine was used for a needle operation on the other eye, when the same symptoms followed, although they were less severe since the dose was reduced.

When cocaine has been injected subcutaneously the symptoms have occasionally proved very alarming, as in the following case:

A woman, aged twenty-eight years,[14] strong and healthy, and not of a nervous temperament, applied to a dentist for the extraction of a tooth; he injected into the alveolus six minims of a twenty per cent. solution, and performed extraction without pain. About ten minutes after the injection the patient was noticed to have a staring appearance, and complained of dulness of vision. Soon she said that it was quite dark, and almost immediately fell back unconscious. When seen by Dr. Schubert, half an hour after the injection, she was lying in a dreamy state with the eyes half open, and could not be roused. The pulse was 80, full and strong. The arms were relaxed, the pupils of medium size, and active. There was no reflex movement on touching the conjunctiva or on pricking the face. Subcutaneous injection of ether produced no effect, but the inhalation of a drop of nitrite of amyl produced an immediate improvement. The patient now moved on being shaken, and answered at first at random, but soon rationally. Complete recovery soon followed, and she was able to go home an hour and a half after the injection. No after-effects followed. The ophthalmoscope was used as the patient was recovering, and the retinal arteries were thought to be somewhat smaller than at a subsequent examination.

Syncope[15] from failure of the heart's action also occurred in a case in which a ten per cent. solution was injected into the skin previous to opening an abscess.

The local troubles which have followed, and been attributed to the application of cocaine to the eye are of two distinct kinds—suppurative panophthalmitis and affections of the cornea.

Heuse[13] saw panophthalmitis follow the excision of a prolapsed iris with the application of the galvanocautery under cocaine, and Bell-Taylor,[16] Nettleship, and MacHardy[17] have reported series of cases in which suppuration has followed cataract operations in which it was employed. One must, however, be cautious of attributing these results to the cocaine. Cases of suppuration do occasionally occur in groups, and all recent investigations into the cause of suppuration in wounds of the eye tend to point to infection of the wound as the probable cause; this might be brought about through the medium of the atmosphere, instruments, etc., or by microörganisms introduced with the cocaine.

In some cases solutions, and in others disks were employed. Fungi often appear in the former when kept too long; while the latter very readily absorb moisture from the air. If, therefore, the suppuration was in any way connected with the cocaine, it was due, probably, not to any direct effect of the alkaloid, but to germ-infection.

We shall presently see that cocaine increases the absorbent power of the cornea, and in this way increases the probability of infection occurring, a fact which renders it doubly important to avoid operating with cocaine during the existence of any conjunctival catarrh.

Corneal lesions have occurred much more frequently, and there need not be the same hesitation in attributing them to the action of the cocaine, since they immediately follow its use, have been known to do so when the solutions used were free from bacteria, and are not known to occur under other conditions. These lesions are of two kinds, epithelial and interstitial, which may be associated, but are not necessarily so.

The first affects the surface of the cornea; this becomes slightly dull and rough, like the finest ground glass; and when touched with the finger, and sometimes spontaneously, the epithelium peels off. Sometimes this desquamation is preceded by vesication. Everbusch[8] was the first to describe this change; it occurred in a healthy young man, whose cornea was perfectly normal, and who was about to undergo an operation on the eyelids, and in a child of ten with squint. Bunge[18] describes four cases, all in elderly people, in which there was loss of the epithelium over a considerable area of the cornea; in none did any ill-effects follow. The writer has seen several such. One of these was a case of divergent squint, in a girl of eighteen. There was an old corneal opacity, but the eye was otherwise healthy. After the fifth instillation of a drop of a five per cent. solution of the hydrochlorate of cocaine, the conjunctiva below the cornea was seen to be slightly swollen; to present a very faint blush; at the same time the cornea looked dull and dry, as is seen in advanced glaucoma. On touching it with the finger the epithelium peeled off over an area of about three millimetres' diameter. The operation was performed, and the next day the cornea had resumed its normal appearance.

Much more serious are lesions of the true corneal tissue. Pflüger[19] records the case of a man, aged sixty-seven, in whom he used a two per cent. solution for an iridotomy after cataract extraction. The wound healed well, but a week after the operation the cornea was still completely anæsthetic, T. —3, and there was ciliary injection. "Typical neuroparalytic keratitis" now came on, and vertical stripes of opacity appeared, deep in the cornea, looking as if they were caused by wrinkling of Descemet's membrane. The constant current was applied, and sensation returned after three applications. By the twentieth day the cornea had almost cleared. There was some anæsthesia of the other eye also, but this was attributed to tight bandaging. The length of time that elapsed before the corneal changes supervened, renders it possible that they were independent of the use of cocaine, but this objection cannot be urged against six cases reported by Bunge,[18] in which a parenchymatous opacity appeared, consisting of vertical stripes extending across the cornea from the wound.

Somewhat different from these cases are five cataract extractions reported by Dr. Wood-White.[20] He had frequently used cocaine, in combination with boracic acid as an antiseptic, but in these five cases he

had substituted a solution of corrosive sublimate for the boracic acid. In all of these there was seen on the second day a pearly-white opacity of the cornea, which in one instance was sufficiently dense to conceal the pupil. The cornea cleared in all.

From the fact that such results have not followed the use of corrosive sublimate in the practice of others, nor that of cocaine in his own, Dr. White concludes that they were due to the simultaneous action of the two drugs, the cocaine in some way rendering the cornea more susceptible to the action of the sublimate. We shall see presently that this hypothesis has since received some confirmation. It should, however, be observed that Dr. White's cases stand on rather a different footing to those already quoted. The fact that the complication occurred in all his cases, while in the hands of others (some of whom certainly used cocaine and sublimate together) the complication is rare, suggests the suspicion that there was some peculiarity in the solutions used by him. The strength of the sublimate solution is not stated, nor is it stated whether the same was used alone in other cases. The opacity does not seem to have had the striated appearance described in the other cases, and cleared up more rapidly. It is, therefore, quite possible that the cocaine had nothing to do with the opacity, and that it would have appeared if the corrosive sublimate had been used alone.

As regards the cause of the vesication and desquamation of the corneal epithelium, Dr. White suggests that the corrosive sublimate may have something to do with this also; but this is certainly not so, for in the writer's case, and in some others, cocaine was used alone. Everbusch (loc. cit.) suggested that it might be due to the dryness of the cornea which the cocaine caused, by keeping the lids open, and thus favoring evaporation. Experimenting on dogs, he found that if the lids were kept closed between the instillations no desquamation took place, and states that since he has adopted this precaution in operations, he has seen no instances of this complication. Later experiments of Würdinger[31] have confirmed this. Into both eyes of a rabbit he instilled a drop of a five per cent. solution of cocaine at intervals of four minutes. The one eye was kept closed between the instillations, but not the other; no corneal changes occurred in the covered eye, in the other there was slight dulness of the cornea after three or four minutes, and twenty to twenty-five minutes after the first instillation the whole cornea presented a very fine roughness, then there appeared superficial depressions looking as if due to shedding of the epithelium, but the reflection from them was normal, and their floor showed no roughness. After the instillations had been continued for an hour, the cornea was so turbid that the condition of the iris could not be made out. To ascertain if these changes really depended upon dryness of the cornea, Würdinger next tried the effect of dropping distilled water, or lacrymal secretions, upon the cornea

between the instillations of the cocaine. This did not remove the changes which had already appeared, but it prevented their increase.

The next experiments were directed toward ascertaining whether this dryness of the cornea was accompanied by a deficiency of lymph in its substance. For this purpose succinyl fluorescine was employed. One eye of an animal was cocainized, and, as soon as superficial changes had occurred, the fluorescine was instilled into both eyes. In the non-cocainized eye there was produced fluorescence of the superficial layers only, which was uniformly distributed. In the cocainized eye, on the contrary, deep fluorescence appeared first, and was there more dense; the superficial and deep areas of fluorescence then coalesced.

When the epithelium was abraded over a limited area on each cornea, and methyl-blue applied in the non-cocainized eye, it merely stained the abraded portion, while in the cocainized it spread thence over the whole cornea. These experiments seem to prove that cocaine increases the absorbent power of the lymph spaces of the cornea, and, therefore, probably diminishes the lymph in those spaces.

Microscopical examination showed that in the early stage the superficial depressions were due to thinning of the anterior lamellæ of the cornea, and that in a later stage the epithelium was absent.

The results of Würdinger's experiments on the combined effect of cocaine with antiseptic solutions were of still greater importance, for he found that solutions of borax, boracic acid, corrosive sublimate, and even of common salt, which were quite innocuous in the normal condition, caused, in the fully cocainized eye, a dense turbidity of the cornea identical with the striated keratitis occasionally seen after cataract extraction.

It is important that these experiments should be repeated and extended, for should they be confirmed, it is evident that a considerable modification of the methods of using antiseptics in operations on the eye may be necessary.

Corrosive sublimate has been used very freely of late as an antiseptic in operations in which cocaine was also employed, and corneal lesions have occurred but rarely; still this is not sufficient ground for acquitting the sublimate of having a share in their production. Further information is needed as to the concentration of the sublimate that is necessary to act efficiently as an antiseptic, and as to what is the strongest solution that can be used without danger to the cornea.

The published reports of many of the cases of corneal lesion following the use of cocaine, do not state whether corrosive sublimate was also used. Many of the cases, however, occurred in countries where the latter is used almost as a matter of routine, while in England, where antiseptics in ophthalmic operations are little used, Dr. White's cases, in which it was employed, are almost the only examples of interstitial changes in the cornea.

As to the form in which it is best to use cocaine, disks are certainly the best for experimental purposes, as the quantity introduced can thus be more accurately measured. For a time it seemed as if they would be the favorite medium for clinical purposes also. Mr. Nettleship's (loc. cit.) statement, however, as to the frequency with which he had seen suppuration follow their use, led to their being to some extent discredited, and their hygroscopic qualities would certainly seem an objectionable feature.

The aqueous solution of the hydrochlorate is most generally used. It has a tendency, however, to become turbid when kept, from the development of a fungus, and some of the ill effects which have occasionally followed its use have been thought to be due to this. Various means have been suggested for keeping the solution clear. Everbusch suggests the following: Take equal parts of a solution of corrosive sublimate (1 to 4000) and a saturated solution of salicylic acid, mix these, and use as a dissolving medium for the cocaine. Würdinger's experiments, however, show that this combination may prove injurious, and the safest plan, at present, is to use fresh aqueous solutions.

It seems now clearly established that little is gained by using strong solutions, and that as great an effect can be procured with a four per cent., or even a two per cent., solution as with a ten per cent., although more time is requisite to obtain the maximum effect.

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A REVIEW OF TWENTY-TWO COTTAGE CASES OCCURRING IN THE WOMAN'S HOSPITAL, IN THE SERVICE OF DR. T. GAILLARD THOMAS.

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It has been the custom at the Woman's Hospital for several years to perform operations in which the peritoneum is exposed, or in which aseptic surroundings are imperative, in a small detached building devoted exclusively to this purpose; and the term "cottage-patient" has become distinctive as regards a class of cases including laparotomies, removal of submucous fibroids filling the vagina, laparo-elytrotomy, etc.

The following cases are all the cottage operations that took place in Dr. Thomas's service while I was senior house-surgeon at that institution. They are of special interest to some of those who watched them, as no pains were spared to carry out antiseptic methods; nothing was taken for granted, and the smallest details were subjected to the personal supervision of the writer. No one who has not toiled with this subject, can appreciate the untiring vigilance that is necessary to secure the observance of antiseptic precautions. For the sake of dealing with the subject systematically and making clear the precautions exercised, four sources may be considered from which septic material can gain access to the wound.

1st. From persons concerned in the operation.

2d. From instruments, sponges, ligatures, and sutures.

3d. From spectators and the operating-room.

4th. From the patient's person.

Under the first head come the surgeon's assistants and nurses, the hands and forearms of the operator, and his perspiration.

The Toilet of the Operating Staff.—All taking part in the operation wash their arms and forearms carefully with soap and water, paring the nails and using a nail-brush. The hands are dipped into a solution of bichloride of mercury (1:2000) and a basin containing a solution of the same strength is within easy reach, so that the operator may cleanse his hand from time to time, particularly before introduction into the peritoneal cavity. When time permitted, it was the custom of the writer to take a bath shortly before the operation, and the hair of the head and face should always be thoroughly cleansed.

The nurse *must comply with the above-mentioned antiseptic precautions.*

Instruments.—All instruments are placed, for an hour before the operation, into 1:20 carbolic acid solution, to which an equal quantity of sterilized hot water is added when the instruments are in use. The

water is taken from the tank of a high-pressure boiler, and carried to the operating-room in demijohns.

Sponges.—The same sponges are used continuously, and to each is sewed a piece of tape, so that it is almost impossible to overlook them when closing the abdominal cavity. After an operation the sponges are carefully washed with soap and water and then boiled for several hours. They are preserved in a glass jar with an air-tight cover, and rest upon a false bottom composed of galvanized rubber which is perforated, and stands in a solution of carbolic acid, 1 : 20. Before use they are soaked for two hours in bichloride of mercury, 1 : 1000.

If a sponge becomes friable, or is difficult to clean, it is replaced, and a new one is prepared by soaking it in a very weak solution of hydrochloric acid for several weeks.

Ligatures and Sutures.—Silver wire is rendered aseptic by immersion, with the instruments, in the solution of carbolic acid before an operation.

Of catgut, that prepared by Am. Emde was used. It is preserved in oil of juniper. No. 3 is the size most used, and Nos. 4 and 5 are at hand.

The silk for the pedicle and ligatures is prepared in the following manner: A piece of solid glass rod is bent in the form of a square, and on this the ligature is rolled, so that all parts are evenly exposed to the boiling solution of 1 : 2000 bichloride of mercury, in which it is suspended for an hour. It is removed from this solution under the spray (the utmost cleanliness as to the hands being observed) and dropped into a solution of carbolic acid 1 : 40. Under the solution it is reeled on a glass spool, and finally placed in a bottle containing 3 per cent. of carbolic acid in alcohol. The bottle, cork, and glass spool are boiled with the ligature. The end of the ligature is carried through the cork by means of a carrying thread attached to a round-pointed needle; all of these articles have been rendered aseptic.

When the ligatures are to be used, they are passed to the first assistant, who pulls a portion out of the bottle, cuts it off, throws it away, and then draws out the part intended to be used. By this method no one touches the ligature except the one applying it. When silk is used for sewing the abdominal wall, as many needles as there are stitches likely to be required should be threaded on the silk. By catching the last needle threaded, holding that fast to the end of the silk, and holding the remaining needles near the cork with the other hand, the annoyance of stopping to thread the needle is avoided. They are retained under an antiseptic solution.

Three varieties of silk are used. That for the pedicle is especially made for this purpose of loosely twisted strands, and is so strong that it cannot be broken with steady traction when used with a surgeon's knot

about the pedicle. The smaller sizes are found useful to ligate vessels, and as sutures.

SPECTATORS AND THE ROOM.—The walls, flooring, and everything in the operating-room should be rubbed with a cloth wet with the chloride of lime, 1 : 10, and the doors and windows thrown open for twenty-four hours, so that there may be the freest circulation of fresh air.[1] For an hour and a half two spray apparatuses saturated the air with a solution of carbolic acid 1 : 40. The solution used is about 1 : 20, but it loses about one-half of its strength by dilution with the steam. The spray is discontinued when the operation commences.

To guard against contamination from spectators, a rope is interposed, at least three feet from the wound.

AUTO-INFECTION.—The abdominal wall is shaved low enough to prevent the pubic hair from reaching the wound, and the abdomen washed with soap and water and covered with a towel wet with a solution of bichloride of mercury, 1 : 1000. This is removed just before the operator makes his first incision.

To prevent auto-infection from cysts containing septic material, the patient is turned on the side when they are evacuated. This procedure, which, I believe, originated at the Woman's Hospital, marks an important advance in the *technique* of operations for the removal of fluid tumors. If done properly, no undesirable fluid can escape into the abdominal cavity, and it is most expeditious. There is no trocar to get out of order and to be found unsuitable.

The cottages where these operations are done have been built for a number of years, and while they were an advance at the time of construction they are not in conformity with modern surgical architecture. They are small frame buildings, about 12 x 26, divided into two equal rooms by a square hallway and closet, between which is a passage connecting the two rooms. The hallway opens at the left side into the nurse's room, in which is a large stove by which the building is heated. There are no sewer connections with these buildings. The water is carried to them in pails and the slops removed by a similar method.

Before speaking of individual cases it would, perhaps, be better, in order to avoid repetition, to mention the routine methods—preparatory, operative, and after-treatment.

The patient's general condition is improved as much as possible, iron and a bitter tonic, and as much sunlight and fresh air as can be taken without causing fatigue. A vaseline bath is given every third night, and the bowels thoroughly evacuated, commencing the catharsis at least one week before the operation. The habits of the patient are taken into

[1] The cleansing of the room was not always as thoroughly done as it should have been owing to the exigencies of the hospital management.

account as to the cathartic selected, but care is taken to avoid active catharsis two days prior to the operation, so that the patient may not be prostrated. The urine is always examined when the patient enters the hospital, and, if loaded with urates, an alkali largely diluted is used. Lithia water, or acetate of potassium (℥ss–Oj), to which is added iron if it be required, is found of service.

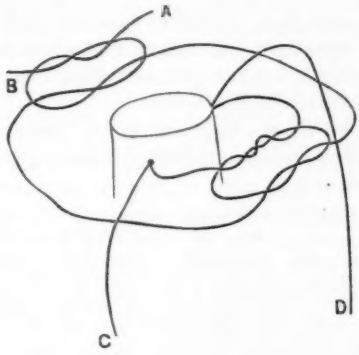
The patient is dressed with thick flannel drawers, stockings, and undershirt, and a blanket is pinned about the lower extremities. These are made to hang over the foot of the table by flexing the legs, and the feet are placed on a rest provided for that purpose. A towel wet with 1 : 20 carbolic acid rests on the blanket.

The operator stands to the right of the table facing his first assistant, on the other side of the patient. The second assistant stands a little back of the first, and between him and a table holding the submerged instruments, and has in his hands a tray with antiseptic fluid containing those instruments for immediate use. Two nurses stand to the left of the operator. One takes the dirty sponges and drops them into a six-gallon pail of hot water. After the blood and serum are washed out they are dropped into a similar pail containing a hot solution of bichloride of mercury, 1 : 4000. The second nurse holds them ready for use in a basin so that the operator can quickly change. If a sponge should fall to the floor it is not used again. A third assistant is responsible for the cautery iron, the Paquelin cautery, and electric light for the abdominal cavity.

Dr. Thomas's method of opening the abdominal cavity is as follows: An incision, three and a half or four inches (the tissues will contract so as to make the length about two inches), is quickly made to the *linea alba* or transversalis fascia. While the *linea alba* is the objective point, a slight variation to one side or the other is disregarded, and the cut continued directly through the muscle. The peritoneum is raised with a fine tenaculum, and snipped with scissors. A director is then introduced and the opening enlarged as desired. Hemorrhage has been checked by Péan's or Well's forceps before the peritoneum is incised. A digital or manual examination of the cavity can now be made. If a cyst is to be evacuated, the patient is turned on the right side, and after securing the sac with Nélaton's cyst forceps, an opening is made by the knife or scissors—a trocar may first be used. If there are endogenous cysts, these are broken up by the hand introduced into the opened cyst cavity. The abdominal cavity has been closed from the external air by sponges about the pedicle in the meantime, and the patient is again turned on her back.

In removal of the uterine appendages the patient is not turned on her side, unless gravity is desired to enable a pus-filled tube (or something of this nature), if accidentally broken, to drain itself on a sponge.

This diagram shows the method of securing the pedicle. The strands *A* and *B* are adjusted and need only be tightened to be secure. *C*



and *D* are merely passed through the stump. They are tied in the same manner as *A* and *B*, with the exception that they pass about the upper half of the stump first. By this method each ligature passes once half and once wholly about the stump, so that it is entirely encircled thrice.

In closing the abdomen, three or four silver sutures pass completely through the abdominal wall, including peritoneum. The edges of the peritoneum are united by a continuous catgut suture, the muscles and fascia by the same thread, and finally, the skin is approximated more exactly by catgut than has been done by the silver sutures.

After sewing the abdominal wall together, the wound is covered with collodion, and before this dries well dusted over with iodoform; over this is placed a piece of iodoformized gauze, and then a number of narrow strips of adhesive plaster to give additional support in case the patient vomits, coughs, etc. This is covered by a roll of cotton batting, and the body encircled by a binder.

The After-treatment.—After the operation has been completed, the patient is placed in bed, where there are several water cans covered with flannel by the sides and at the feet. The room is darkened, and no one permitted near but the nurse, who is directed not to talk to the patient. If there is much pain it is controlled by compound solution of Magendie hypodermatically administered. A few small pieces of cracked ice may be held in the mouth, or two or three drops of lemon-juice to overcome nausea. I think that washing out of the stomach, immediately after the operation, in all these cases would prove most useful.

If the patient is in fair condition, no attempt to administer nourishment is made for twenty-four hours, and if quite strong, nothing is given for thirty-six hours. If by this time the gas has been passed freely, and there is no pain, a tablespoonful of milk or chicken-broth and lime-

water is allowed every four hours, and an enema of beef peptonoid, half a drachm added to milk with a little liquor opii is given every four hours, alternating with the milk. Stimulants are used by the rectum, if indicated. No solid food is allowed until the sixth day. The pulse, temperature, and respiration, are taken every four hours, and if the nurse is skilful this can be accomplished without disturbing the patient. The temperature is taken in the vagina.

I wish to make my acknowledgment to Dr. Thomas Keith, of Edinburgh, for his kindness in communicating to me his practice in this important stage of these cases.

CASE I. *Commencing malignant disease of the uterus; removal of diseased tissue; recovery.*—Mrs. K., æt. forty-four; no children; last miscarriage twenty-seven years ago. Principal symptom has been a bloody discharge for six months, which has of late been very offensive. Dr. Thomas sent her to the hospital with the diagnosis of commencing malignant disease. Her general condition is excellent.

Sept. 26. Dr. Thomas drew down the cervix with a stout tenaculum, and removed a cone-shaped mass, including the diseased tissue, with a pair of sharp-pointed scissors slightly curved on the flat. The uterus was thus shelled out. On account of the hemorrhage it was necessary to apply two heavy silk ligatures at right angles, running up in the axis of the uterus, to draw together the bleeding surfaces. A number of smaller ligatures were used. Ligatures left hanging into vagina, and a tampon soaked with bichloride solution, 1 : 2000, used. This was removed on the third day, when there was a slight odor.

Oct. 14. All ligatures have come away. The discharge, which has been quite offensive, and required frequent douchings, has now markedly diminished. Patient sitting up.

25*th.* Patient left hospital.

Jan. 1886. Dr. Thomas heard from patient, who is feeling very well; no return of discharge.

CASE II. *Ovariotomy; recovery.*—Mrs. K., æt. twenty-three; no children; no miscarriages. About six months ago noticed general enlargement of abdomen. She has had no pain, but felt a dragging sensation in loins on assuming the erect posture. No other symptoms except vesical irritability and slight increase in monthly flow. Examination revealed a thin-walled cyst; fluctuation readily obtained, and equal in all directions. Uterus retroflexed and carried to the right.

Oct. 3. Dr. Thomas removed an ovarian tumor weighing 14½ pounds, in a little less than ten minutes. The left ovary presented several small cysts, which were punctured; also a small pedunculated fibroid, which was removed after its pedicle had been ligated. The ovary was then returned.

When the patient entered the hospital, at the right apex was heard high pitched and prolonged expiration, and the patient gave a history of cough for several months. In the second week after the operation, there were abundant râles at the right apex and free expectoration. The evening temperature would run as high as 103°, and the patient complained of severe sweats in the afternoon. Treatment: Fresh air, as much food as could be digested, stimulants, etc. The active process stopped finally, and March 1, 1886, she wrote that she was doing nicely.

CASE III. *Ovariotomy; death.*—Miss H., æt. fifty-one. Noticed general abdominal enlargement for one year—distinctive tumor appreciated two months ago. Principal symptom is pain on left side and inconvenience of tumor mass. General condition poor.

Oct. 17. Dr. Thomas removed an ovarian tumor from the right side. There were a few strong adhesions but no other complications.

21*st.* The patient died; the cause of death is unknown. The pulse had been very weak but not particularly rapid until the afternoon of this day, when the temperature ran up to 106° F., and the pulse to 130. She was comatose for a couple of hours before death. The autopsy showed much fat about the heart, but the fibrillæ were not affected. The patient had passed a fair amount of urine and it contained no albumen. There had been some oozing from the stump, not more than an ounce of odorless, fluid blood was found.

CASE IV. *Hegar's operation; recovery.*—Miss S., æt. thirty-two. Menstruation has been quite profuse, and the patient suffers greatly from abdominal pain. The symptoms arise from the weight caused by a large mural fibroid. She is a factory girl, dependent on her own exertions for a living.

Oct. 10. Dr. Thomas performed Hegar's operation, removing the ovaries without the tubes. The peritoneum was closed by continuous catgut suture; the pulse and temperature rose gradually after the operation, and emesis was continuous. On the second day after the operation the pulse was 138, temp. 102.5° F., resp. 14, and the patient was vomiting incessantly. On the fourth day the temp. was 105° F., and pulse 152. On the morning of the fifth day the abdomen was reopened, but nothing found. From this time the patient made a good recovery. A mural abscess developed a few days after the abdominal cavity had been reopened, but no local tenderness at that time existed, although it was carefully sought for.

August, 1886. Examination by the writer showed that the mass was smaller, but nodules could now be detected that were not before apparent. Patient says she has very much less disturbance, and is sure the mass is much smaller. The nodules that are now apparent were probably present before the operation, but atrophy in some portions of the tumor has changed its position.

CASE V. *Removal of the ovaries and tubes; recovery.*—Miss H., æt. twenty-four. Has suffered intensely at her menstrual periods for years. She was under treatment for a long time at her home in the West, and as a last resort was sent to New York City. The ovaries were enlarged, tender, and prolapsed.

Oct. 10. Dr. Thomas removed the ovaries and tubes. The patient made a good recovery; there was no complication. June 2, 1886, she writes: "I can endure a great deal of exercise with very little fatigue, and feel better than ever before in my life."

CASE VI. *Ovariotomy; recovery.*—Mrs. D., æt. thirty-four; seven children. One miscarriage three years ago. Two years ago her abdomen commenced to enlarge, and she has lost a great deal of flesh in the past seven months. Suffers from pain in the side for the past six weeks. Examination made evident the signs of a simple cyst.

Nov. 21. Dr. Thomas removed a large ovarian tumor from the left side. There was a varicose condition of the veins of the broad ligament, some being as large as one's thumb. The right ovary was normal. Time of operation twelve minutes. There were no after-complications.

I heard from the patient several months after the operation and she was doing bravely.

Case VII. *Removal of fibroid; recovery.*—Mrs. W., æt. forty-three; no children; no miscarriages. Has flowed excessively for a year. Was in the hospital five months previously, and Dr. Thomas diagnosticated a large fibro-myoma of the uterus of the submucous variety. He thought it was best to wait at that time, and in the meanwhile to have the patient carefully watched. He thought that by delaying, the pedunculation would be more fully accomplished. When she presented herself at the hospital the second time, she was so weak and anæmic that a fainting fit would follow an attempt to assume an upright posture. The fibroid filled the vagina, and from pressure, and poor nutrition, it had commenced to slough on its external surface. Her principal symptoms at this time were vesical irritability and dragging pains. She had had morphine for the past two weeks.

Oct. 28. Dr. Thomas removed the mass by the vagina piecemeal, with a very powerful pair of scissors; at times cutting with the greatest care, and at others removing boldly pieces as large as half a kidney. The mass altogether weighed a little less than three pounds, when the blood had drained away. The patient was very weak, and the hemorrhage was controlled by steady traction on the uterus with a stout tenaculum, held by the writer.

February 25, 1886, this patient writes: "I am gaining strength and flesh very rapidly."

Case VIII. *Removal of fibroid*; *recovery.*—Mrs. K.; laparotomy and removal of a fibroid tumor and drawing up the vaginal wall to cure a vaginal hernia. This case is reported in full by Dr. Thomas in a paper read before the Academy of Medicine, December, 1885, and published in the New York *Medical Journal*, December 26th of the same year.

Case IX. *Removal of dermoid cyst of ovary; recovery.*—Miss McC., æt. twenty-six; has suffered more or less pain for months. Has had slight vesical irritability for years. Examination shows a large mass wedged in the pelvis. The uterus is thrown forward and crowded up against the symphysis pubes, and measures four and a half inches in depth. The mass felt so hard, that the writer thought it was a fibroid of the posterior wall of the uterus.

Nov. 9. Dr. Thomas removed a dermoid cyst of the left ovary. The contents consisted of reddish hair, several imperfect teeth, and a large mass of fatty fluid. The right ovary and tube removed on account of cystic degeneration in the ovary.

Complications: A large mural abscess; otherwise made a good recovery. Have heard of the patient through others within the past five months, and she is doing well.

Case X. *Ovariotomy; recovery.*—Mrs. F., æt. thirty-four. Two children, youngest twelve years of age. She has suffered from digestive derangements and bearing-down pains for about a year, and for the same time has noticed two lumps in the abdomen side by side. Examination revealed two dense cysts connected to the uterus and each other.

Nov. 9. Dr. Thomas made the usual incision. There were dense adhesions in all directions, and after working to the side, a slate-colored cyst wall presented. The cyst was evacuated in the usual manner. The adhesions to the small intestine were very numerous. These were broken

up as gently as possible by the sponge and the fingers, and the cyst removed. Below the position of the cyst, and to the right, was discovered a smaller papillomatous mass about the size of an orange. After much difficulty, on account of hemorrhage, this was removed. It proved to be the right ovary. A large number of silk ligatures were left in the abdominal cavity, and a long glass drainage tube was used.

On the seventh night the tract of the drainage tube was washed out carefully, and, afterward, twice daily, as the discharge was quite large in amount, and rapidly became offensive when not thoroughly cleaned. The temperature could be maintained nearly normal by this means.

This patient has been under my care since the operation, on account of a fistulous tract that has not yet entirely closed. This is probably due to a ligature, and as it gives her very little inconvenience, I have advised her to wait patiently until it comes away. I am the more inclined to give this advice, as I have known of a somewhat similar case where death followed operative interference.

CASE XI. *Ovariotomy; recovery.*—Mrs B., æt. fifty-one, no children, five miscarriages; the last, five years ago. Menstrual flux normal. She was tapped five months ago for dropsy, but the relief was of short duration. First noticed increase in size one year ago. The principal symptoms are great emaciation, and discomfort from the presence of a large cyst.

Nov. 4. Dr. Thomas removed a large ovarian cyst; there were no adhesions, and the patient made a good recovery. The temperature was never above 100° F. I heard from the patient nine months after the operation, and she felt very well.

CASE XII. *Abdominal abscess; laparotomy; recovery.*—Mrs. K., æt. twenty-three; no children; suffering from hectic for past six months. Abdominal cyst discovered. It was thought to be an abscess.

Nov. 21. Dr. Thomas made the usual incision. When the peritoneum was reached everything was found matted together. On opening the abdominal cavity, a slight tear made an opening, through which welled up stinking pus. Dr Thomas seized the sac with a tenaculum, and held it so that not a drop escaped into the abdominal cavity. There was over a quart of this offensive purulent fluid. The wound was washed out with a solution of mercuric chloride, 1 : 4000, and the wound closed after the sac was securely fastened to the abdominal wall. A long glass drainage tube was left projecting from the sac. The cavity had been closng up so nicely from the bottom, that when she left the hospital a two and a half inch tube was substituted for the original one of six inches.

The sac was kept clean by repeated antiseptic douches. The temperature was taken every four hours, and if above 100° F. the interval between the washings was diminished. It was done on some days every second hour. The discharge continued sweet after the first few washings. The patient had been much run down before the operation, but improved so much afterward that she became impatient because of the restraints of the hospital, and took "French leave."

CASE XIII. *Removal of uterine appendages; recovery.*—Miss M., æt. thirty-three. She has suffered from pain in her left side, particularly at the menstrual periods, until life has become a burden. She is a school-teacher, dependent on a salary for her maintenance, but is unable to do any work at the time of her periods. She has undergone varied treatment from many physicians, but with no benefit. The uterus, which is

retroflexed, was at one time replaced forcibly, while the patient was etherized, but, as might have been expected, she was not relieved.

Nov. 25. Dr. F. P. Chambers removed both ovaries and tubes. No complications except that a small cyst ruptured in removing the right ovary, but the fluid was clear.

In this case the ovaries and tubes were as healthy as many women have who probably never have a symptom of pelvic trouble. I have removed much worse specimens after death, where there was no history of any symptoms referable to this pathological condition, yet no one who was well acquainted with the facts in this case, could have doubted the indications for this operation, judging entirely from the results.

I quote from a note received from this patient December 4, 1886: "I received your note this week, and am very happy to say I feel perfectly well. My head troubled me at first very much but it is constantly improving, and does not trouble me more than once a day (month?). I was unwell but twice, that being the two successive months after the operation. It took a long time to regain my strength, but I can say now that I never felt stronger or better. I have gained about twenty pounds."

CASE XIV. *Ovariotomy; recovery.*—Miss S., æt. twenty-six, for four months has noticed her abdomen increasing in size. The principal symptoms are due to inconvenience caused by the size of the mass.

Nov. 28. Dr. Thomas removed a twenty-two pound tumor of the right ovary. There had been suppuration in the cyst. The left ovary, which was enlarged and cystic, was removed with the tube. No complications. The patient made a good recovery.

CASE XV. *Removal of parovarian cyst; recovery.*—Miss R., æt. twenty-two. For four years her abdomen has steadily increased in size, most noticeably on the right side. The increase has been much more rapid for the past few months. Principal symptoms: nausea and shortness of breath. This patient came alone from Cuba. She was unable to speak a word of English, and I cannot refrain from a passing tribute to the courage that enabled her to come among strangers and undergo so serious an operation.

The patient had a severe chill after the operation, and her temperature ran up to 103° F. This readily responded to quinine; otherwise the case was uneventful.

CASE XVI. *Removal of ovarian cyst from right side, and of uterine appendages from the left; recovery.*—Mrs. H., æt. twenty-nine; no children, and no miscarriages. Well until one year ago, when her abdomen began to increase in size. The growth has been more rapid lately. It has seemed stationary for the past two months. Principal symptoms: inconvenience of locomotion and dyspnœa.

Dec. 5. Dr. Thomas removed an ovarian cyst from the right side. The pedicle was about eight inches in length and very thin. The left tube was enlarged and, with the ovary, bound down. From it stood out a gelatinous mass about as large as a thimble; this was broken in removing it. The ovary and the tube both removed. The temperature went up the first few days to 102.3° F., otherwise there was no complication. The patient was heard from nine months after the operation and was doing well.

CASE XVII. *Removal of uterine appendages; recovery.*—Mrs. B., æt. twenty-eight. Since the birth of her last child two years ago, she has

suffered very much at her periods and at other times. She has a marked anteflexion, but the uterus easily admits a large sized probe. She has been under treatment for two months in the hospital and for a long time outside of this institution.

Nov. 23. Dr Thomas removed both ovaries and tubes. The tubes and ovaries on both sides were bound down by strong adhesions. The usual three layers of sutures used, but they were all of catgut. There were no complications. I heard from this patient a few months after the operation, but she felt no better, and thought she was somewhat worse.

CASE XVIII. *Removal of uterine appendages; recovery.*—Mrs. G., æt. twenty-two; no children; no miscarriages. This patient suffered for eleven years from dysmenorrhœa. She has been under treatment for more than two years. An ovary found prolapsed, and much inflammatory action about it. She has been in the hospital, and under observation for four months.

Jan. 2. Dr. Thomas made the usual incision, and found the tubes largely dilated and full of blood; these, with the ovaries, removed; she made a good recovery; no complications. I heard from her seven months after the operation; feeling very well, except for vesical irritability, which troubled her previous to the operation.

CASE XIX. *Removal of uterine appendages; recovery.*—Miss L., æt. twenty-three; has never menstruated; at periods of about twenty-eight days she has suffered from bearing-down pains. She was sent to the hospital for operation with the diagnosis of hæmatometra. It was ascertained that this diagnosis was incorrect, and it proved to be a case of undersized uterus and enlarged ovaries and tubes. She was sent away from the hospital, the dangers of the operation being strongly presented to her mind. In a few months she returned, saying she did not care to live and suffer as she was doing. She was a school-teacher.

Dec. 23. Dr. Thomas removed the tubes, which were dilated as large as small lemons, and full of clotted blood. The ovaries were the size of horse-chestnut burrs, and also filled with coagulated blood; they were also removed. There were no complications, and the patient made a good recovery. I heard from her some time since the operation, and she is doing well.

CASE XX. *Removal of ovarian cyst from left side, and of appendages from the right; recovery.*—Mrs. G., æt. twenty-eight; never pregnant. Her principal symptoms are, increase in size of the abdomen, which she has noticed for the past four months. She has also suffered from abdominal pain.

Jan. 16. Dr. Thomas removed an ovarian cyst of the left side. The right ovary was found cystic, and was also removed, with its tube. The operation was complicated by a band of tissue between the abdomen and the cyst. This was tied with silk, and divided. The highest temperature was 100.4° F. The patient left the hospital well. She has not been heard from since.

CASE XXI. *Removal of uterine appendages; recovery.*—Mrs. S., æt. twenty-seven; never pregnant; suffers from pain in her abdomen. Has had pelvic peritonitis several times.

Jan. 16. Dr. Thomas removed both ovaries and tubes. The left tube was much enlarged and filled with pus; both tube and ovary bound down by very strong adhesions. The tube was ruptured in removing it, and part of its contents escaped into the abdominal cavity. Right ovary and

tube firmly bound down. The tube was enlarged. The patient made a fair recovery from the operation.

Jan. 16, 1887. Mrs. S. writes: "I have felt very well, and have not needed any medical treatment."

CASE XXII. *Removal of uterine appendages; recovery.*—Mrs. M., æt. thirty-five; three children; the last child was still-born, three years ago; has had *grand mal* for three years. The periods between these attacks have grown less, and now appear every two weeks. Examination shows an enlarged and very tender ovary on the right side.

Jan. 23. Dr. Thomas removed ovaries and tubes. There were no complications, and the patient made a good recovery. She left the hospital in the middle of February.

THE STATION OF MAN, CONSIDERED PHYSIOLOGICALLY AND CLINICALLY.

BY GUY HINSDALE, M.D.,
OF PHILADELPHIA.

IN forming an opinion of a man's physical condition it is desirable to observe not only his gait, but also his power of preserving an erect position while standing—which we technically call station. Even before any question may be asked, the physician can form an approximately correct opinion of the disease as the patient walks into his office, and stands before him.

For some time past Dr. Weir Mitchell's attention has been directed toward bringing to an arithmetical precision of statement certain symptoms which we are usually obliged to record with more vagueness of statement than is desirable. One of the most important of these inquiries has been as regards station. For this purpose, Dr. Mitchell suggested and used a simple form of apparatus, already described in a paper by Dr. Morris J. Lewis and himself. At this point, at his request, I took up this study.

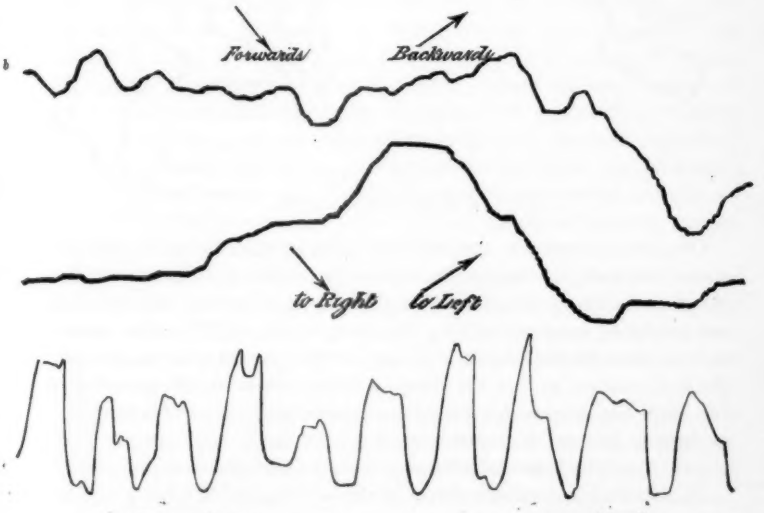
In order to do this accurately, it was necessary to construct certain apparatus so that the disturbances of equilibrium might be recorded. This was done with the assistance of Prof. Reichert, in the Physiological Laboratory of the University of Pennsylvania.

To observe the sway of a healthy man, the subject was made to stand with his heels and toes together; his hands were allowed to hang by the side; the head was held erect, the eyes being directed at a fixed object. A record of motions in the antero-posterior line was made by attaching a silk thread to a fillet over the forehead; the thread passed over a pulley, and was connected with a rod moving vertically, and carrying an index. This index marked a smoked paper attached to a

drum, which revolved laterally by means of clockwork. A downward movement of the index and a fall of the line scratched on the smoked paper, indicated a forward movement of the head; and an upward line recorded the backward movement.

In like manner the lateral movement was recorded. A silk thread was attached to the side of the head, and was carried at right angles to the forward and backward line, for a few feet, and thence by a pulley so as to move a needle and index at the side of the one recording antero-posterior movement, upon the same blackened surface. The sway for the two directions was thus resolved into upward and downward movements on the same paper. By means of a tube connecting the mouth

FIG. 1.



a, five second spaces.
b, movement antero-posteriorly.
c, movement laterally.
d, respiration curve.

with a diaphragm which moved a lever and index, the respirations were also, in some instances, recorded. Seconds were marked on the paper by means of clockwork and an electric index. Such a tracing is shown in the accompanying engraving.

Other tracings were taken by attaching to the top of a man's head a flat piece of cardboard, upon which was stretched some smoked paper. The subject was then placed under an index, free to move up and down,

in a fixed line, and which traced curves on the paper as the subject who stood beneath swayed in any direction. This is the clinical method in practical use at the Infirmary for Nervous Diseases. A tracing from a case of locomotor ataxia is here shown.

FIG. 2.

Sway of a locomotor ataxic.

Other measurements were taken by placing the subject in front of a scale graduated in inches, and noticing the amount and direction of sway, the observer being seated about ten feet distant, and the head steadied; one eye being used in making the observation. When this has been done in front of the subject, the latter is then placed at a right angle to the first position, so that the antero-posterior sway may be recorded; or two observers may make these records simultaneously. The subject in no case is allowed to touch anything; the heels and toes are placed together, and he is not told the object of the inquiry.

This is the coarser method in practical use at Dr. Mitchell's clinic.

It was, of course, found that no man could stand absolutely still; the body swayed forward and backward, and from side to side, in every instance. The sway in the antero-posterior line was found to be greater, as a rule, than the lateral sway; the antero-posterior ranged in health from one-third to one and a half inches; the lateral sway from a quarter to an inch and a half. On closing the eyes, the sway was decidedly increased. This increase shows to how great an extent we use our eyes in correcting these oscillations. When we shut our eyes we cease, to a large degree, to correct these differences.

The first movement is almost invariably forward, then there is a counterbalancing effort, bringing the body backward, and usually to the right. The more pronounced sway is in the antero-posterior line, as may be seen in the tracings; as resultants of these, and of lateral sway, there are minor curves.

Clinically, certain abbreviations may be used in the records of cases, as follows: A. D. (antero-dextral). A. S. (antero-sinistral). P. D. (postero-dextral). P. S. (postero-sinistral). A. 1 D. ¾, would mean that the subject swayed forward one inch, and to the right three-fourths of an inch. This we have found to be the average for normal adults.

The records showed a law of irregular rhythmical motion. This was noticeable chiefly in the forward and backward movement, but these waves of motion did not correspond with respiration as a whole or fractionally.

Respirations per minute were recorded as follows: 21.5, 23, 20–21, 23, 31, 28, 29, 22, etc. In one observation, extending over three minutes, the subject, a healthy Irishman, employed in the physiological laboratory of the University of Pennsylvania, respired in the first minute 27 times, in the next minute 28 times, and in the third minute 26½ times. The tracing, as usual, showed certain waves of antero-posterior motion; of these there were during each of the first three minutes, 12, 11, and 11 respectively. In another instance, in the same individual, the respiration was 22, and the antero-posterior waves 14. In the writer's case, 13 of these waves and 24 respirations were recorded in one minute. Thus the normal man has a rhythmical sway of about 14 to the minute. What governs this as to number is not clear.

A very large percentage of the normal individuals observed seemed inclined when losing their equilibrium to fall forward and then slightly to the right. The motion is greatest in the forward and backward line. The subject, as a rule, does not go so far backward as forward and not so far to the left as to the right.

We have endeavored to ascertain whether the sway to the right or to the left may be coincident with right-handedness or left-handedness. While right-handed people almost invariably are inclined to tilt over to the right, of 22 left-handed people 12 were inclined to tilt to the left.

This at once opens the whole subject of asymmetry. That the right side of the body, as a whole, is usually larger than the left, in persons who are right-handed, is generally accepted. The difference is noticeable in the shoulders and upper extremities. The right arm displaces several more cubic inches of water when immersed in a tube up to a given point, and is stronger than the left.

The weight of the arms being unequal the centre of gravity is, therefore, slightly on the right side; and it has been found that a man who has lost an arm sways to the sound side. "The weight of the arms is so

important in correcting the oscillations of the centre of gravity in walking, that if one be lost a runner needs another of the same weight."[1]

The careful weighing of the muscles of the legs and of the back, excised from the body, has shown the right to be in excess.

The cause of this excess is doubtless finally to be referred to the central nervous system. The left cerebral hemisphere, from its slightly greater size, especially in the motor area, and greater density, has been termed the "leading side."

In connection with this it is interesting to state that Flechsig found the decussation of fibres in the anterior pyramid unsymmetrical, more crossing from the left brain to the right of the cord than in the opposite direction. It may, therefore, be that decussation of the motor fibres renders the right side of the body, from a muscular standpoint, the leading side. But Flechsig also found that nearly all the fibres decussated in some instances, forming the posterior column of the lateral opposite half of the spinal cord; however, in rare cases, almost none of the fibres decussated. It would be interesting to determine whether, in these cases, the subjects were or were not left-handed.

As an antithesis to this, M. Bourdon's observation is noteworthy. In the case of a man who forty years previously suffered a disarticulation of the *left arm*, the *right brain* showed a decided depression of the ascending frontal convolution, the paracentral lobule and the convexity of the right hemisphere; there was also enlargement of the right lateral ventricle, due to very extensive atrophy of adjacent white substance. The *right brain* weighed thirty-one grammes less than the left.[2]

The point I wish to make clear is that cerebral development and activity have a direct relation to muscular development and activity of the opposite side of the body. It would therefore not be irrational to suppose that, by educating the muscles of the left side until they were superior to those of the right, the right brain might then be made the leading side and the recognition of this might possibly give to those of delayed mental development a new centre for the cultivation of the powers of both mind and body.

In maintaining the erect position a large number of muscles of the body are in constant activity. Subjects must sway not only to the heavier side but also to the stronger side. The predominating muscles not only exercise this greater influence of their own, but there is probably added an increment of energy due to automatic tone waves created by the constant strain of other muscles in a state of tension.

This factor, combined with actual excess of tissue, produces in most persons an antero-dextral sway. The sinistral sway is found in a

[1] Hall and Hartwell, Johns Hopkins Univ., "Mind," No. xxxiii.
[2] Revue de Thérapeutique, Med.-Chir., No. 11.

majority of left-handed people. It is found rarely in those who are right-handed.

Twelve individuals, mostly young men in good health, were carefully observed, tracings of the sway being recorded on the drum. There was, with the eyes open, a maximum antero-posterior sway of 1.56 inches and a minimum of 0.32 inch, the average being one inch. Laterally the average was 0.78 inch, the maximum being 1.50 inches, and the minimum 0.24 inch.

With the eyes closed these figures were considerably increased. The averages for forward and back and for lateral sway were increased 80 per cent. and 28 per cent. respectively, making 1.8 inch for antero-posterior, and 1 inch for lateral sway. These figures may be considered normal for young men in health.

Allowing the eyes to wander about the room, though the head be not turned—in other words, the absence of fixation of the eyes, reading aloud, and removal of the shoes and stockings, increase the bodily sway. In one instance the lateral sway of a man was one-fourth of an inch. Removal of the shoes and stockings increased this to $1\frac{3}{4}$ inches. The antero-posterior sway in the same instance was 1.52 inches, but after removal of shoes 2.88 inches—almost double. Comparisons made with eyes shut, with shoes and without shoes, showed a corresponding increment. In the writer's case this increment was 16 per cent. for antero-posterior and 12 per cent. for lateral sway. In a number of observations the increase of sway varied considerably; no changes were observed excepting that of extent of the oscillation.

Twenty-five girls, between the ages of seven and thirteen, were examined in orphanages. The lateral sway averaged 1.06 inches, the antero-posterior sway 1.08 inches. Shutting the eyes increased this sway about 40 per cent.

Eleven boys yielded slightly greater figures than in the case of girls—an increase of 7 per cent. for lateral sway, and 13 per cent. for antero-posterior sway.

Children sway absolutely more than adults, and there is a greater equality in their cases between the antero-posterior and the lateral sway.

Thirty-nine inmates of the Institution for the Blind were examined, by permission of Dr. Harlan. The average lateral deviation was found to be 1.4 inches; the antero-posterior deviation 1.7 inches. This is about the normal sway of healthy individuals with their eyes shut, and shows that the blind, even after years of experience, are not able to preserve their equilibrium better than the man who is momentarily deprived of eyesight.

Seventeen deaf-mutes, between fourteen and twenty-four years of age, were examined at the Institution for the Deaf and Dumb, by permission of Dr. Wharton. The average lateral sway was found to be 0.93 inch,

and the average antero-posterior sway 0.85 inch. With the eyes shut the sway increased so that the average for lateral sway became 1.18 inches, an increment of 27 per cent., and the antero-posterior sway 1.31 inches, an increment of 54 per cent. It may be said of these figures that the boys are trained in military practice, and that their shoes are stout and have broad soles. They were all right-handed; they all swayed to the right excepting two, one of whom swayed to the left, the other swayed to both right and left.

Opportunity was taken at this time to test the liability of deaf-mutes to become dizzy. It was discovered by Prof. William James, of Harvard University,[1] that deaf-mutes, in whom the semicircular canals are frequently diseased or destroyed, are not so likely as others to lose their equilibrium or to become dizzy. Three boys were turned rapidly about while standing on their feet; they were then told to walk rapidly down a line on the floor. Although they were turned a dozen or more times, they were all able to walk a straight line without wavering. A fourth confessed he was very dizzy, and diverged widely from the line. The three who were first tested were far better able to keep the line than was the writer.

The influence of ether on station was also observed, with the aid of Dr. W. C. Lott. Tracings from both of us were obtained. We took the ether in the standing position so that the index of the apparatus could write at any desired moment. As the ether was taken the writer seemed to be pivoted as a top when nearly done spinning, and finally it seemed as though the feet were not resting upon any solid foundation. The tracings, apparently, do not show anything more than a great exaggeration of the normal sway.

In several cases of locomotor ataxia the sway with the eyes open was observed to vary from 2.25 inches to 3.75 inches in the antero-posterior line, one from 2.50 inches to 3.25 inches laterally. One of these has been engraved. Six observations with the eyes shut showed a lateral sway of 3 to 6 inches, and antero-posteriorly 3 to 7 inches. An interesting tracing of a case of spastic paralysis showed that the oscillations were almost wholly in the antero-posterior line. Ten tracings from cases of chorea were taken. With the eyes open, the lateral deviation averaged 1.45 inches; the antero-posterior deviation, 2.35 inches. The sway slightly increased when the eyes were shut.

As a result of these observations there arise certain valuable formulæ which point to further physiological research and have direct clinical utility.

They show that the normal man and woman have an average sway of

[1] The Sense of Dizziness in Deaf-Mutes. By Wm. James, M.D. Amer. Journ. Otology, Oct. 1882.

about one inch in the forward and back line, and three-quarters of an inch laterally.

That children sway to a slightly greater extent than adults, and that, both in adults and in children, closing the eyes increases the sway about 50 per cent.

An artificial agent, such as ether, simply exaggerates the normal sway.

That a law of rhythmical motion governs the sway of man. The cause of this is not yet clear.

The methods introduced by Dr. Mitchell for studies of this kind enable clinical inquirers to make accurate statements which may be comparable with the observations of others.

EXCISION OF THE ENTIRE CLAVICLE FOR CENTRAL CARCINOMA.

By John Sloan, M.D.,
of New Albany, Indiana.

James F. M., of Washington Co., Indiana, came to my office November 21, 1885, with his physician, Dr. Maxedon, to consult me in relation to an enlargement of his right clavicle. He was fourteen years old, large and robust. Had had pain in the bone since May; observed an enlargement October 15th, and consulted his physician. It had grown rapidly, extending upward and inward, the greater enlargement about two and a half inches from the sternum. I advised its immediate removal.

He returned November 28th, accompanied by Dr. M. and two other physicians of his town, who, with several others of this city, assisted in the operation. On examining the mobility of the shoulder, before placing him on the table, I fractured the bone, which made the operation more protracted. He took chloroform kindly. An incision was made from the centre of the sternum to a little beyond the acromial extremity of the bone; the parts were dissected from the anterior surface; it was disarticulated from the scapula, a noose of cord placed around it for traction; and it was carefully separated from its connections with probe-pointed scissors and scalpel to the place of fracture. The sternal fragment was seized with forceps, disarticulated from the sternum, and carefully dissected out. Arteries as divided were seized and held by compressors. Capillary hemorrhage was arrested by hot sponges.

The time occupied in the removal was forty-five minutes. Three small tents of twisted marine lint were placed in the wound for drainage, it was closed with wire sutures, dressed with a compress of marine lint

and bandage. No vessels required ligation. The drainage tents were removed on the second day; there was moderate suppuration from two places. The sutures were removed on the seventh day; union was complete at the extremities, and a portion of the centre.

On January 13th he returned home, thirty miles, by stage. The wound was healed, except two small points which had scabbed over. Dr. Maxedon remained with and cared for him the first ten days. His highest temperature was 101½°, on the second day; afterward normal. Morphine was given for a few nights to procure sleep, and an occasional laxative.

The circumference of the bone, three inches from the sternal articulation, was five and a half inches. On section it presented a thin shell of bone exteriorly with calcareous infiltration throughout the interior; I dissolved the bony and calcareous material in dilute hydrochloric acid, made some sections, stained them in picro-carmine, and mounted them in glycerine. They showed a dense stroma of connective tissue, with some spindle cells, and large nests of cancer cells. He visited me about the 5th of April; there was evidence of the return of the cancer in the line of the cicatrix, and in the glands of the neck.

REVIEWS.

RECENT WORKS ON OPHTHALMOLOGY.

THE REFRACTION AND ACCOMMODATION OF THE EYE, AND THEIR ANOMALIES. By E. LANDOLT, M.D. Translated by C. M. CULVER, M.D. Edinburgh: Young J. Pentland, 1886.

THE HYGIENE OF THE EYE IN SCHOOLS. By HERMAN COHN, M.D. Translated by W. P. TURNBULL. London: Simpkin, Marshall & Co., 1886.

THE DIRECTION OF THE LYMPH-STREAMS IN THE EYE. By H. GIFFORD, M.D. *Archives of Ophthalmology*, June, 1886. New York: Putnam & Sons.

A CONTRIBUTION TO THE STUDY OF SYMPATHETIC OPHTHALMITIS. *Archives of Ophthalmology*, Sept. 1886.

REPORT OF THE COMMITTEE ON SYMPATHETIC OPHTHALMITIS. *Transactions of the Ophthalmological Society of the United Kingdom*, vol. vi. 1886. London: J. & A. Churchill.

ON A CASE OF MENINGITIS FOLLOWING EXCISION OF THE EYEBALL. By E. NETTLESHIP. *Archives of Ophthalmology*, September, 1886.

EITRIGE MENINGITIS NACH ENUCLEATION. By R. DEUTSCHMANN. *Archiv für Ophthalmologie*, xxxi. iv. p. 251.

L'ANTISEPSIE COMME MOYEN PRÉVENTIF DES DANGERS DE MORT APRÈS LES OPERATIONS ORBITAIRES. By L. DE WECKER. *Annal. d'Oculist.*, Jan., Feb., 1886.

TRAITÉ COMPLET D'OPHTHALMOLOGIE. Par L. DE WECKER and E. LANDOLT. Tome III. fasc. 3e. Paris: 1887.

SUBJECTIVE SYMPTOMS IN EYE DISEASES. By G. BERRY, M.D. Edinburgh: Oliver & Boyd, 1886.

THE CAUSES AND PREVENTION OF BLINDNESS. By DR. ERNEST FUCHS. Translated by DR. R. E. DUDGEON. London: Ballière, Tyndall & Cox, 1885.

DISEASES OF THE EYE. By DR. FERDINAND VON ARLT. Translated by S. WARE, M.D. Edinburgh: Young J. Pentland, 1886.

OUR object in the following pages is not so much critically to review the works enumerated above as to consider in what direction the science and practice of ophthalmology are likely to be affected by them; we shall therefore have little to say concerning their defects and omissions, but shall deal almost entirely with their positive aspect.

The estimation of correction of errors of refraction forms so large a

portion of ophthalmic practice that no apology is needed for dealing first with works on this and allied subjects.

There can be no question that Dr. Landolt's work will, for many years, be the standard authority on refraction. The scientific study of this branch of ophthalmology may be said to date from the publication of Donders's *Anomalies of Refraction and Accommodation*, and Helmholtz's *Physiologische Optik*. Since then, no original work of importance has appeared, and although many minor treatises have been written, these have dealt almost exclusively with the means of diagnosticating the more common abnormalities, and have made no attempt to treat the subject exhaustively. Since 1860, however (the date at which Donders's book appeared), very great changes have been introduced. The use of the ophthalmoscope has become more general, and its construction immensely improved, the refraction instruments which a few years ago were expensive instruments, only possessed by a few, are now the rule, and, as a consequence, great importance is attached to all objective tests. The introduction of the metrical system and its adaptation to the measurement of convergence have much simplified calculations. At the same time an enormous amount of information, statistical and otherwise, has been collected on the subject of myopia and the causes of its increase. All these facts point to the want of a standard work which shall serve as a fresh starting-point. This is to a great extent supplied by the book before us.

Of the physical portion there is not much to be said, since most of the facts are now common property. The mathematical elements are less prominent than in Donders, while an abundance of excellent illustrations saves much verbal explanation. The optical constants adopted are those of Helmholtz, and this portion of the book will be extremely useful for reference.

Our chief interest here, however, is with the clinical portion. The author's optical treatment of ametropia differs considerably from that adopted generally. In hypermetropia he makes no attempt to correct the whole or even nearly the whole of the defect, but encourages the patient, even in distant vision, to use two-thirds of his total accommodation. For instance, a patient with hypermetropia of 5 D., whose amplitude of accommodation was 3 D., would still be permitted to use two dioptres of an accommodation, and would therefore be ordered + 3 D. The correction for near vision is calculated in the same way. It appears to us that the plan ordinarily adopted of correcting the whole of the manifest hypermetropia and a constant fraction of the latent, is more sound theoretically, and practically as satisfactory. Dr. Landolt's plan, indeed, appears to aim at correcting as little of the hypermetropia as may be, while the aim of the other is to correct the defect as nearly as possible, and thus coax the patient to relax his accommodation.

The optical treatment of myopia has always been a matter on which there was some diversity of practice. On this subject Dr. Landolt has no hesitation, but emphasizes the following rule by printing it in small capitals, "A myope must be prohibited from wearing concave glasses for any distance at which he can see without accommodating." In other words, a myope of 3 D. must be forbidden to wear his correcting glass when looking at objects at 33 cm. (13 inches) or nearer. This would, we believe, entail considerable inconvenience upon many patients without any corresponding advantage. For years past it has been the prac-

tice in England to allow myopes of moderate degree to wear their full correction for all purposes, except when the disease is progressing, and no harm has been found to result.

The author's well-known interest in all that relates to the ocular muscles gives to his remarks on this subject an authoritative character. This part should be read in connection with the chapter on the same subject in the *Traité complet.* We are at present probably only on the threshhold of this subject, and much remains to be done. This portion of the book, however, forms an able *résumé* of our present knowledge, for much of which we are indebted to Prof. Landolt himself.

Donders's statements as to the relations which exist between convergence and accommodation still hold good, and the adaptation of the metrical system has rendered it more easy of demonstration. Nearly all the facts, however, as to the relative amount of convergence and divergence possible to different individuals are more modern. The rules for guidance in the adoption of operative or other treatment are laid down upon a logical basis. The position of parallelism of the visual axes is denoted by zero, and divergence and convergence are expressed in metrical angles with the sign — or + prefixed. The normal standard taken is an amplitude of convergence of ten metrical angles (m. a.), of which one is negative and nine positive. This may be departed from in many ways. The range of convergence may be normal, but the whole may be carried too far to the negative or positive side, or the amplitude may be curtailed at either or both extremities. Whenever the positive convergence fails there is asthenopia in near vision. Convergence is measured by means of Landolt's ophthalmo-dynamometer and divergence by prisms. Tenotomy of the abductors diminishes the negative portion of the range, and increases the positive at least to the same extent, and usually, if the adductors are sound, to a greater extent. It is, of course, only available when part of the range is negative, or actual convergence would be produced. When the internal recti are weak, as shown by shortening of the positive range, it does little good and one or both internal recti must be advanced. If the external recti are weak tenotomy of the internal may be performed also. When the amplitude of accommodation is much below normal the case is not well adapted for operative interference.

A work of a totally different character, yet dealing with very kindred subjects, is Cohn's *Hygiene of the Eye in Schools.* It is not, indeed, a new work, but until the appearance of this translation it was not very familiar to English readers. If some such book were used as a text-book for all engaged in teaching we should see less of the evil effects produced during school-life from ignorance of the capabilities of the growing eye. Its appearance is especially opportune just now, when there has been a tendency shown to minimize the evils of myopia, and to regard it in some quarters simply as a physiological adaptation of the eye to the requirements of civilized life. After an introductory portion adapted for the laity, we come to the real pith of the book—a description of the faulty positions assumed by school-children, and the defects of school desks, bad illumination, and faulty type, which necessitate or facilitate such positions.

The main interest of the book from a medical point of view, however, centres round the oft-quoted statistics. These should be read in conjunc-

tion with Dr. Randall's comprehensive paper "Refraction Statistics," *American Journal of the Medical Sciences*, 1885. These prove conclusively that the number of cases of myopia and its degree progressively increase from the lower to the higher classes of schools, and are greater in the higher than in the more elementary schools, in which the average age of the scholars is the same.

Of late years the views prevalent regarding refraction have been greatly modified. It may now be considered established that hypermetropia is the normal condition at birth, and that emmetropia is seldom reached till the age of six or eight, that after this age a considerable proportion of children become myopic.

Much more valuable, in our opinion, than these colossal statistics are those, more limited in number, which show the changes undergone by individual eyes in a certain number of years.

It was long believed that hypermetropia was a stationary condition, and that the cases of myopia were derived from eyes which were originally emmetropic. No less an authority than Donders has expressed the opinion that hypermetropic eyes did not become myopic. If, however, all eyes are originally hypermetropic it is evident that this view must be abandoned; indeed, the statistics just referred to seem to show that a very considerable number of children who are still hypermetropic at the commencement of school-life eventually become myopic. Nor is it possible any longer to maintain that sharp distinction between progressive and stationary myopia which has, until lately, been customary, for there are numerous statistics which show that myopia nearly always continues to increase to some extent during the whole of school-life. Of course, there is marked and most important difference between a myopia which ceases to increase at puberty, or thereabouts, and is unaccompanied by atrophic changes in the choroid, and that form of it which continues to increase throughout life, and is accompanied by atrophic changes in the region of the posterior pole. Landolt and others name the first typical myopia, and the second atypic or malignant.

Of the statistics showing changes taking place in the same individuals we quote those of Erisman and Reich,[1] as in each the interval was as long as six years (the latter are not given by Cohn). Erisman found 23 per cent. and Reich 25 per cent. only whose refraction had not increased. Of cases of hypermetropia which had passed into myopia Erisman found 13 per cent., while the proportion of emmetropes who had become myopic was only slightly greater, namely 16 per cent. Reich's figures are much higher, but the relative proportion is nearly the same. Now when it is considered that the slightest increase in the refraction of an emmetropic eye renders it myopic, while the hypermetropic has first to become emmetropic, it is apparent that the eye which remains hypermetropic beyond the normal period, is one which, under the influence of school-life, is very liable to become myopic. There are statistics to determine whether myopia thus produced is of a rapidly progressive character.

The last volume of the *Transactions of the Ophthalmological Society*, though containing much that is of interest, will contribute most to the permanent advance of ophthalmology through the comprehensive report

[1] Arch. für Ophthal., xxxi.

of the Committee on Sympathetic Ophthalmitis, and Mr. Nettleship's paper on "Meningitis following Enucleation."

In connection with the former we take Gifford's important papers, which have certainly thrown new light upon the pathology of sympathetic inflammation. The author states that his experiments were originally undertaken with the intention, and in the expectation, of confirming Deutschmann's results. To make the significance of Gifford's results apparent it will be necessary briefly to glance at the position to which Deutschmann's[1] experiments had brought our knowledge of the pathology of this affection. Injecting pyogenic micrococci into the vitreous of one eye in rabbits, he had almost always succeeded in producing papillitis in the other, which persisted till the death of the animal, which always occurred within a few weeks. On examining the parts, the microörganisms were found in abundance in the intersheath spaces of both optic nerves, in greater quantity as the globes were approached, and around the chiasma. When the infecting material was introduced into the optic nerve which had been ligatured on the proximal side, inflammation of the uveal tract was set up, from which it was concluded that the immunity enjoyed by this in the other experiments was due to the early death of the animal. In order to test the applicability of these experiments to sympathetic ophthalmitis as it occurs in man, culture experiments were made with aqueous, and portions of iris removed during life from the sympathizing eye. The microörganisms thus reared appeared to possess all the properties of those inoculated in the original experiments, and they produced the same effect when injected into the rabbit's eye. The existence of microphytes in the exciting eye having been previously proved, the chain of evidence as to these being the cause of the inflammation of the second eye seemed fairly complete, and it was not unnaturally concluded that the microphytes had travelled from the first eye to the second along the optic nerve sheaths and chiasma. Their passage might indeed be considered proved, but as regards their mode of transit there were at least two weak points in the evidence. In the first place, it is necessary to assume that in one nerve they travelled against the lymph stream. Secondly, why should they be more redundant near the globes? An obstruction at the papilla of the second eye would explain their accumulation behind it, but why should there be a similar condition in the nerve of the first eye? Gifford's experiments throw light upon both these points. In his first paper he cleared the ground by showing the direction of the normal lymph currents between the eyes and the brain. In numerous experiments injections of colored substances were made into the vitreous with the following results:

"When a small drop of sterilized water, containing Indian ink or cinnabar in suspension, is introduced there is generally little or no reaction. The next day, or later, if the injection is made far forward, one sees with the ophthalmoscope the particles collecting in the optic excavation; if the animal be killed a day or two later, the central canal is marked by a black or red line which leaves the nerve with the vessels, and can be traced a short distance toward the apex of the orbit. Microscopically one sees that the granules are contained in the perivascular lymph spaces. They can also be traced along the small vessels given off to the papilla, nerve, and choroid. None were found in the intervaginal or dural sheath. . . . Anthrax bacilli followed the same course, but did not enter the finest canals. As they multiply where-

[1] Archiv für Ophthalmologie, xxx. iii.; xxvii. ii.; xxix. iv. etc.

ever they are carried, they are found in considerable number in the orbit, and if the animal lives long enough, in the cranial cavity."

These experiments clearly demonstrate the existence of a lymph current from the vitreous to the brain along the bloodvessels.

Gifford then repeated Quincke's[1] experiments of injecting cinnabar into the cerebral subdural space after trephining, and found that it travelled down the intervaginal space of each optic nerve, being more abundant near the globes. The fact that the suprachoroid can be readily injected from the intervaginal space perhaps answers one obvious objection to the bacterial theory of sympathetic inflammation—namely, that the chief stress of the affection is not upon the optic papilla and retina, but upon the uveal tract.

Gifford's second paper has a more immediate bearing upon pathology. His experiments with the same microörganisms as were used by Deutschmann led to very different results; the animals did not die, there was no permanent effect produced on the other eye, and, although there was inflammatory exudation into the sheaths of the nerve for some distance behind the eye, in no instance did the micrococci themselves extend beyond the lamina cribrosa.

We do not propose to discuss the several explanations which might be given of these experiments, giving different results to those of Deutschmann, but pass to Gifford's experiments with the anthrax bacillus. One difficulty with this bacillus is, that if the subconjunctival tissue is inoculated the animal dies. It was exceedingly difficult to prevent this, hence the negative result as regards affection of the second eye of the majority of the experiments. The three cases, however, in which this was affected are extremely instructive. In each the bacilli could be traced along the vessels to the apex of the orbit; they were present in the cranium around the chiasma; they were to be traced *down* the intervaginal space of each nerve, increasing in quantity near the eyes.

It is manifest that these experiments are too few to establish any theory upon. Still, taken in conjunction with those bearing on the course of the lymph-currents, they are significant. While strengthening the theory that migration of microörganisms is the exciting cause of sympathetic ophthalmitis, they render it extremely doubtful whether the optic nerves can be considered as the direct channel of communication. If the mode of infection suggested by these experiments should be confirmed by others, several difficulties, which have hitherto stood in the way of accepting the bacterial theory, will be removed, and if there is really this double road by which the bacilli can travel, it is not at all impossible that a relapse of inflammation in a sympathizing eye may react upon the exciting eye, a possibility in favor of which there is some clinical evidence.

The report of the Committee of the Ophthalmological Society on "Sympathetic Ophthalmitis" is of a different nature from the papers just quoted, the evidence being entirely clinical. The report is based upon 200 cases collected from various sources. Of these, fifty ended in complete recovery, and a very considerable number had useful vision. Obviously, however, this does not give the real percentage of recoveries, as there would be a much greater tendency to publish the successful cases. The same difficulty, though to a less extent, arises in estimating

[1] Reichert's and Du Bois Reymond's Archives, 1872.

the effect of various modes of treatment. The Committee have rightly been chary of drawing conclusions, and have merely arranged the facts bearing on the different points. Some conclusions do seem, however, fairly deducible. We should say that Mauthner's view that enucleation of the exciting eye aggravates a mild attack of sympathetic inflammation, if not disproved, is, at any rate, rendered extremely improbable.

One of the points on which the Committee endeavored to collect evidence was as to the possibility of sympathetic ophthalmitis occurring without a perforating lesion of the exciting eye. Considering the very wide field over which the evidence was sought, it is impossible to avoid the conclusion that had this been possible unequivocal examples would have been found. Of course, it is necessary to exclude at the outset all cases in which the first eye suffered from spontaneous irido-cyclitis from a constituted cause, for in such it is impossible to exclude the action of the same cause upon the second eye. The only cases admissible would be those of injuries without perforation, or of affections which are dissimilar to sympathetic iritis (for a constitutional cause would not produce different symptoms in the two eyes). Since, however, spontaneous uveitis may occur in the second eye, it is evident that cases must be accepted with great doubt in which the affections of this eye did not appear until long after the usual interval which separates the affection of the two eyes in true sympathetic ophthalmitis. Now of the eight cases which have been selected as the only ones approximately fulfilling the conditions, in two there was an interval of sixteen and twenty years respectively, while in the remainder the evidence of no perforation having occurred was far from being conclusive. Genuine cases, had they occurred, would certainly have been published and the absence of such is strong evidence of their non-existence. It is evident that this strengthens the view of the septic nature of sympathetic inflammation.

The series of cases in which the symptoms did not appear in the second eye until after removal of the injured eye is of great interest. The general mildness of these cases seems clearly to point to enucleation being likely to influence the course of sympathetic inflammation favorably. There are numerous other points on which the evidence is very suggestive, but for these we must refer to the report itself.

That meningitis which is generally fatal occasionally results from enucleation has long been known. The cases, however, that had occurred were scattered throughout medical literature, and it was difficult to estimate the frequency of the complication or to arrive at definite conclusions as to its pathology. In the papers of Nettleship, Deutschmann, and de Wecker attempt has been made to collect all the published cases, and although these probably represent but a proportion of those that have actually occurred, much can be learnt from their comparison. Perhaps a better idea of the percentage of the enucleations that are followed by meningitis can be formed by taking the percentage of individual operators. Thus de Wecker and Alfred Gräfe, *Exenteration ver Enucleation Bulbi*, 1884, give an almost identical percentage—namely, 0.3 per cent.

Deutschmann's paper gives an account of twenty-six cases, de Wecker of one that is not included in this, Nettleship gives one of his own, and six others not previously published. We have thus a total of thirty-four cases; it would be well, however, to exclude one of Deutschmann's in which the operation was complicated by the removal of a malignant tumor from the orbit, and one of MacHardy's, in Mr. Nettleship's paper,

in which the eye was not enucleated, but torn out by the patient himself.

De Wecker's case is not free from doubt, since there is no record of the temperature, and the patient died at home. No post-mortem examination was made.

Several important questions arise in connection with these cases. In the first place, the uniformity of the interval that separates the operation and the commencement of the symptoms leaves no doubt that the meningitis was really caused by the operation. Thus, in twenty cases in which the interval is given, it was twenty-four hours or less in eleven, between twenty-four and forty-eight in five, and over forty-eight in only four (Nettleship). Whether the condition of the enucleated eye has any share in causing the meningitis is a question that has been much discussed, but which cannot at present be determined. The condition is mentioned in twenty-seven instances, in fourteen of these suppurative panophthalmitis was or had been present. Long ago von Gräfe laid down the dictum that an eye should not be excised when in a state of active suppuration, and, as there are no data to show to what extent this rule has been followed, it is impossible to say what value can be attached to the above figures. It is curious that of the five cases which recovered after developing symptoms of meningitis, four were cases in which there had been no suppuration.

In all the cases except four there had been a perforating lesion of the enucleated eye, and, therefore, the possibility of septic inflammation. De Wecker attributes considerable importance to inoculation of the orbital tissues with the contents of the globe at the time of the operation. As a matter of fact, rupture of the globe did occur in a considerable proportion of the cases, and inoculation could easily occur in those in which the wound was recent or unhealed.

The post-mortem appearances were extremely variable, the meningitis was of a purulent character in nearly all, generally affecting the convexity of the brain as well as the base, and in some instances being even more marked in the former situation. Although the sheaths of the optic nerve offer the most obvious channels for the transmission of the inflammation, changes were found in only three instances, while in six others the most minute microscopical examination failed to discover any abnormal condition in the nerve sheaths. The cellular tissue of the orbit appeared to be normal in nearly all the cases. The implication of the convexity leads Nettleship to think that the veins form the channel of communication, which might be the case without there being obvious changes in them. In view of Gifford's investigations as to the course of the lymph stream from the eye to the brain, infection travelling along the central vessels of the optic nerve is by no means impossible. There are, probably, however, several channels by which the inflammation may travel, and it is possible that the same are not always implicated.

This subject, of meningitis following enucleation, has an especial importance at the present time because attempts have recently been made to introduce substitutes for the operation. Both in Deutschmann's and de Wecker's papers it is contended that exenteration is safer in this particular respect. We do not propose to enter here on a discussion of the relative advantages and disadvantages of these two operations. It is obvious that their relative safety in regard to a complication which occurs only three times in a thousand operations can at present only be

discussed on theoretical grounds. If the meningitis is in any way dependent upon inoculation with the contents of the eye, then it surely must be safer to remove these enclosed in a dense covering of normal tissue, as is done in enucleation, than to make an incision into the inflamed cavity and remove piecemeal as much of the contents as possible as is done in exenteration. In this latter proceeding inoculation of the conjunctival wound cannot be avoided, and it is impossible to follow microörganisms into crevices formed by irregularity of tissues, or the orifices of vessels. If, on the other hand, it is assumed that the meningitis results from infection of the wound at some period subsequent to the operation, this ought to be obviated by using strict antiseptic precautions. Practically the choice between exenteration and enucleation will be decided on totally different grounds.

If we were asked in what respect ophthalmology has recently contributed most to the advancement of medical science, we should point to the aid that it has afforded to the localization of cerebral affections. The present position of science in relation to this important subject is well delineated in a most able and exhaustive article by J. P. Nuel in the last volume of the *Traité Complet*. In conjunction with this might be read Dr. Berry's little book, which, although in many instances merely touching the surface of the subjects treated of, yet forms a valuable contribution to the medical aspect of ophthalmology.

As showing how recent has been the advance of our knowledge in this respect we may remind the reader that it is only quite in recent years that the question of partial or total decussation of the optic nerve was keenly discussed, whereas now, not only is it universally admitted that the fibres of the right halves of the two retinæ go to the right optic tract, and *vice versa*, but much progress has been made in tracing them to their ultimate destination.

In regard to the latter there is, however, still considerable difference of opinion. According to Charcot, all the fibres which do not decussate at the chiasma do so a little behind the corpora geniculata. According to this view, lesion of one hemisphere behind this point would produce total blindness of the opposite eye. This scheme has, however, not been generally adopted, and the clinical evidence appears to be against it. Nuel seems to ignore Charcot's theory, does not discuss the probability of there being any decussation behind the chiasma, and considers the whole matter settled by the following rather bold assertion, "numerous examples of homonymous hemianopia (*i. e.*, loss of the right or left halves of both visual fields) from lesion of the opposite hemisphere, especially of the cortex of the occipital lobe, prove that all the fibres of one optic tract go to the hemisphere of the same side." It is evident, however, that this assertion is too sweeping, since Ferrier (*The Functions of the Brain*, 1886) gives sufficient experimental and pathological evidence to show that sometimes the blindness thus produced is only temporary, and that in several experiments the lesion of the whole of one occipital lobe, and even of both, has not been followed by any impairment of vision. On the other hand, destruction of one angular gyrus produces total blindness of the opposite eye and not hemianopia. The only scheme which at present appears consistent with all the facts is that proposed by Ferrier, namely, that each occipital lobe, in virtue of the semidecussation at the chiasma, is in relation with the corresponding half of each retina, but

that each angular gyrus is in relation with the fovea centralis of the opposite eye only, some of the fibres decussating near the corpora geniculata, and others at the chiasma.

Nuel lays down very clearly the character of hemianopia from cerebral lesions, the sharp limitation and symmetry of the scotomata being important features. The loss of activity by the pupil, when the lesion implicates the optic tract, and its retention when it is in the occipital lobe, are also pointed out.

Both this author and Berry mention the fact that in hemianopia from lesions of the tract, the optic disk of the eye of the side opposite to the lesions shows signs of atrophy before the other; this is explained by the fact that the direct fibres are covered by the crossed ones.

In Dr. Berry's book are some valuable hints as to the significance of the impairment of the light-sense; this is a subject which has been allowed to fall very much into oblivion; yet it may sometimes afford valuable indications—for instance, when there is considerable opacity of the vitreous, the fact that the light-sense was not much impaired would, it is said, exclude the existence of the detachment of the retina. In glaucoma simplex there is great diminution of vision with feeble illumination, and but little difficulty in distinguishing between different degrees of intensity in the light, whereas in optic atrophy these conditions are reversed. There is, however, much practical difficulty in applying subjective tests of this nature to patients of only average intelligence.

Dr. Berry discusses the somewhat difficult subject of the vision of those who are color-blind very clearly, and ably supports Hering's theory that color vision depends upon the existence in the retina of three substances, each of which is acted upon in two ways by opposed (or complementary) colors, and that defects in color-vision depend upon the absence of inertness of one of these. This theory necessitates the view that color-blindness cannot exist for one color, but must concern a pair of complementary colors. Perhaps the best proof that this is really the case is furnished by Masson's disk; the colors are so arranged that the sensation of gray is produced in the normal eye when the disk is rotated; amongst the colors are placed two which are complementary. If both these are removed, the effect of gray is preserved, while if only one is removed a sensation of color is produced. Now to the color-blind also the first mixture appears gray; if, however, only one color in it failed to affect the sensorium, the remainder should give rise to a color impression. If, however, we admit that defect for one color necessitates also a defect for its complement, that does not altogether disprove the Young-Helmholtz theory, though it certainly weakens it.

Professor Fuchs's essay on the "Causes and Prevention of Blindness" is a valuable contribution to ophthalmic literature, since it brings to a focus our scattered knowledge upon a variety of subjects, and presents it as a vivid picture. It touches on many points which are of importance to several sections of the community. The chapter devoted to the effect of school-life upon the eyes well deserves the serious attention of all who have to do with school construction or management. The ground is much the same as that covered by Cohn's *Hygiene* already referred to, but the enormous difference in the demands made upon the school children of Germany and England is well brought out, a difference which has its fruit in the great prevalence of myopia in the former. The plan

of lighting by the electric light that is recommended, is to have a very bright light hung from the centre of the room, beneath this a concave mirror which conceals it from view, and throws the light on to the white ceiling from which it is reflected to all parts of the room. Probably this, when the conditions are properly observed, would give the nearest approach to diffuse daylight that could be obtained.

We propose, however, to confine our attention to the medical points of interest. In the chapter on congenital and hereditary affections, the question of the influence of consanguinity of the parents on the occurrence of retinitis pigmentosa in the offspring is discussed with more impartiality than has previously been the case. Many previous statistics have been vitiated by the circumstance that they have been compiled from exceptional sources—for instance, the inmates of asylums for deaf-mutes; but a large proportion of these are known to be the offspring of consanguineous marriages. Taking 147 cases of retinitis pigmentosa collected from various ophthalmic clinics, 34 per cent. were found to be the offspring of consanguineous marriages. Now the proportion of these marriages (in France) to all marriages is only about 1 per cent. There is, of course, the obvious objection that the cases of retinitis were collected from several countries, and the statistics of marriages from France, but the disproportion is too great to be explained thus.

In dealing with contagious affections of the conjunctiva, Fuchs adopts the classification of Arlt, which has not generally been followed, though there is much to be said in its favor. Blennorrhœa is divided into acute and chronic, the former including all forms of purulent ophthalmia, and the latter muco-purulent and granular ophthalmia, the papillary and follicular granulations being considered as different manifestations of an identical disease. The main argument in favor of this is that in an epidemic of ophthalmia all these affections are met, and that a considerable number of instances have been observed in which different affections have followed infection from the same source. Sattler appears, however, to have been mistaken in considering the micrococcus found by him in trachoma as identical with the gonococcus. According to Zehender (Bowman, lecture, *Lancet*, Nov. 27), the trachoma microzoon "is a diplococcus very like the gonococcus, but smaller, and cleft by a tiny line. It can be cultivated in various media, whereas the gonococcus will only propagate in blood serum."

Arlt's book is of interest as embodying the views of one who has probably had a very much larger experience than any living ophthalmologist. It is, however, only the first part of a projected work, and the subjects with which it deals—affections of the conjunctiva, iris, and cornea—are not those which give much scope for originality. Unfortunately, the manuscript appears to have been completed before cocaine came into use; and, although the translator has endeavored to supply the defect by numerous interpolations, the success is naturally but indifferent.

The classification of the different forms of conjunctivitis has been already referred to. The evidence in favor of infection through the medium of the air is fully discussed, a possibility which is consistent both with clinical facts and with what we know of other infecting material. It has, however, been denied by Stellwag von Carion and other authorities. The section devoted to sympathetic inflammation is meagre,

and not up to date. No well-marked distinction is made between sympathetic neurosis and ophthalmitis. The theory of excitation through the medium of the ciliary nerves is adopted; but the arguments that have been adduced against it are not mentioned, neither are Deutschmann's experiments. Indeed, the whole section reads as if it had been written ten years ago. There is an interesting section devoted to the cysts of the iris that occasionally follow a perforating wound, but Hulke's well-known paper on the subject is not referred to. W. A. F.

RECENT WORKS UPON OPERATIVE SURGERY AND SURGICAL TECHNIQUE.

1. THE PRINCIPLES AND PRACTICE OF OPERATIVE SURGERY. By STEPHEN SMITH, A.M., M.D., Professor of Clinical Surgery in the University of the City of New York. A new and thoroughly revised edition. 8vo. pp. 877. Philadelphia: Lea Brothers & Co., 1887.
2. MANUAL OF OPERATIVE SURGERY. By JOSEPH D. BRYANT, M.D., Professor of Anatomy and Clinical Surgery in Bellevue Hospital Medical College, New York, etc. 8vo. pp. xxvi.–530. New York: D. Appleton & Co., 1887.
3. MANUAL OF OPERATIVE SURGERY. By W. ARBUTHNOT LANE, M.B.M.S., F.R.C.S. 12mo. pp. 276. London: George Bell & Sons, 1886.
4. HOW WE TREAT WOUNDS TO-DAY. By ROBERT T. MORRIS, M.D., late House Surgeon to Bellevue Hospital. 16mo. pp. 162. New York: G. P. Putnam's Sons, 1886.

1. THE first edition of Dr. Stephen Smith's magnificent work was issued in 1879, and it has since gone through eight large issues, but without any alteration of the text. The present edition is, therefore, called the "second" by the author, but we think he does himself injustice in so doing. If we understand the matter correctly, this is the tenth edition, and we bear witness that it is "thoroughly revised." This work is too well and too favorably known to require any words of commendation, and its merits effectually protect it from adverse criticism. It is not a manual of operative surgery, but a treatise upon the principles as well as the practice of mechanical surgery, requiring for its elaboration 877 large octavo pages. The subject-matter is brought down to the very latest period, hence we shall find the work to be a faithful exponent of the art of surgery as it is practised now.

So comprehensive is the scope of the work that it might almost be considered a treatise upon the whole science and art of surgery. The opening pages call attention to the "civil obligations of the surgeon," in which it is stated that "whoever undertakes to practise any art or profession assumes an obligation, both civil and professional, which, though implied, has all the force and validity of a formal contract." This obligation requires that he shall possess: 1st, reasonable skill, knowledge, and experience; 2d, that he shall use ordinary care in the exercise of his skill; and, 3d, that he shall use his best judgment. As

the science of surgery is a progressive one, those who practise the art must assume new obligations as advances are made, hence it is held by the author, and we heartily agree with him, that "antisepsis implies new obligations" upon the practitioner, and "if, through ignorance or negligence, he fail, in any given case, to apply these principles with reasonable care and diligence, he would be justly held responsible for any unfavorable results due to conditions which antiseptic treatment would have prevented."

Following such a statement as we have just quoted, it is but to be expected that there shall be a thorough discussion of the principles and practice of antiseptic surgery, and this is done in a simple manner which can be readily understood by any one. Whilst the author is earnest in his advocacy of the antiseptic method, it is with the great principles of surgical cleanliness that he concerns himself, rather than with any special line of antiseptic practice. Surgeons are pretty well agreed at this time upon the best methods of antisepsis, and but few confine themselves to the original Listerism, or to any other rigid and unalterable system. Soap and water for cleansing purposes, irrigation of the wound and the part to be operated on with solutions of bichloride of mercury, carbolic acid solutions for disinfection of instruments, and a combined iodoform and sublimate dressing for the wound, with certain modifications here and there, form the method most in vogue at this time, and the various details of the application of these agents are fully discussed in the text. In view of the splendid achievements of modern surgery we feel tempted to exclaim, "bold is he and with triple brass around his chest who commits his fragile (surgical) bark to the cruel waves" of chance, without first invoking the protection of antisepsis.

A short section is devoted to the consideration of wound fevers, and it does not seem to us that justice is done to these important complications, as but three and three-quarter pages are devoted to them. It also seems to us that the pathology of these affections is more settled than would be expected from a perusal of the context. Many subjects are carefully considered which are usually omitted in works on operative surgery, amongst these are fractures and dislocations. These very important and practical topics are rather briefly, but succinctly, treated.

We are glad to note the judicious conservatism of the author in regard to new and unsettled procedures; thus, in speaking of fractures of the patella his views are eminently wise and conservative. He presents a tabular statement of the results of wiring the patella, as follows: total cases, 182; recent, 81; old, 53; results good, 75; fair, 35; poor, 24; suppuration, 34; amputation, 4; deaths, 11; total ankylosis, 14; not known, 31; under treatment, 9. "In simple fracture without complication, wiring the fragments gives no better results, as far as relates to the usefulness of the limb, than the judicious employment of apparatus," an opinion which tallies exactly with our own. We have never been able to see how it could be justifiable to cause the death of four or five persons in every hundred in order to obtain a slightly better functional result. We are surprised that no mention is made of Kocher's method of reducing dislocations of the shoulder, which is, we believe, a very great oversight, as it is certainly one of the easiest, safest, and most successful of all the many procedures which may be used for effecting reduction of this dislocation.

The section devoted to the osseous system includes fractures, dislocations, diseases of the bones, and joint-diseases; and whilst it is impossible to treat exhaustively of so many subjects in 117 pages, the descriptions of the diseased conditions, and especially the mechanical and operative procedures necessary to remedy them, are clear and practical. The subject of operations upon bone, resections, excisions, osteotomy, etc., is particularly well handled; not only are the usual typical operations described, but the various osteoplastic methods which have come into use during the past few years.

The fourth section is devoted to diseases and injuries of the circulatory system, including ligation of the arteries. The next section is devoted to the diseases of the nervous system, and, as is to be expected, considerable space is taken up with cerebral localization. The remarkable operation of R. J. Godlee is mentioned, but the brilliant work of Victor Horsley is probably of too recent a date to have secured mention in this book. Fluhrer's remarkable case of removal of a bullet from the brain, by trephining upon the opposite side of the head from that at which the missile entered, receives merited mention. Nerve suture and nerve stretching receive brief notice, scarcely as much as their importance demands.

Passing over the chapters devoted to affections of the tegumentary system, the lips, tongue, pharynx, and œsophagus, all of which receive adequate treatment, we pause to seek the opinion of the author in regard to the new operations upon the stomach. He seems to hold a somewhat neutral position in regard to the justifiability of gastro-enterostomy, digital divulsion of the pylorus, and pylorectomy, and prefers to await further developments in regard to them, but says all surgeons should be familiar with the details of these operations. In regard to penetrating wounds of the abdomen, and especially those inflicted by firearms, Dr. Smith says:

> "The experience of the past has been that shot injuries of the small intestine are always fatal if treated upon conservative principles, but the experience of the present is that some patients may be saved by exploring the abdominal cavity, cleansing it of all effused matters, and closing the wounds of the viscera."

He, therefore, adopts Senn's dictum that the surgeon who allows a patient to die from a penetrating abdominal wound without, at least, proposing laparotomy "has failed to discharge the duties imposed by modern surgery." Whilst we believe these views to be true in the main, we think they are a little too sweeping. We do not think there is any doubt that recoveries took place after gunshot wounds of the small intestine during the late war, but they were very few in number. Dr. E. G. Waters, of Maryland, reports in the *Medical and Surgical History of the War of the Rebellion*, a case of gunshot injury of the abdomen in which he, at least, considered the small bowel to have been wounded; the patient recovered and was alive and in good health at a recent date.

The consensus of professional opinion at this time is decidedly in favor of laparotomy in these abdominal injuries, and we think justly so, but the question is far from settled. Should laparotomy be performed in every case of penetrating wound? What cases may be left to nature? What are the comparative results of expectant, and of operative treat-

ment, etc.? are questions which further observation will determine, but which will require a great war or series of conflicts for their solution.

The treatment of intussusception is summarized: First, quiet spasm by giving opium or belladonna; second, attempt reduction by forcibly, but gently kneading the bowels, changing the position from time to time. If these measures do not succeed, not more than two days should be allowed to elapse before proceeding to laparotomy. The author's position in regard to laparotomy for intestinal obstruction in general, is that which is held by most surgeons at this time: try medical means, opium, enemata, posture, etc., and if they do not succeed perform abdominal section after the lapse of three or four days.

The length which this review has already reached admonishes us that we must omit any special notice of operations upon the liver, spleen, pancreas, and kidneys, as well as of the radical cure of hernia, all of which will be found carefully considered. The author does not apparently approve of attempting the radical cure of hernia at the time of operation for strangulation, at least there does not seem to be any mention of it. Extirpation of the larynx is recommended in cases of malignant disease within that organ, but the results are not held to be encouraging.

This work will be found to represent the prevailing surgical opinions very faithfully, not only in regard to the recognized operations, but to those which are struggling for recognition as well. We must, however, pass over many subjects of marked interest, and pause at the chapter devoted to amputations; here every form of amputation is described, and amongst these methods none is better in many respects than the "hood flap" of Dr. Smith. The last chapter is devoted to the consideration of "compensative appliances," artificial limbs, etc.

In conclusion, we may be allowed to say that Stephen Smith's *Operative Surgery* is one of the most complete works in the English language, and is a fit companion to Malgaigne's magnificent treatise, after which it is patterned. The wood-cuts are in the main good, and are very numerous. The descriptions of operative procedures are plain, and the opinions expressed conservative and judicious. The work reflects great credit upon the author and upon American surgical literature.

2. With Stephen Smith's and Stimson's works already in existence, Dr. Bryant undertook what would have appeared to most persons an almost impossible task—that is, the preparation of a manual of operative surgery which should possess individual merit to such a degree as to give it a place in the surgical literature of the day. We think he has succeeded to a very marked degree. Bryant's manual is not so comprehensive as Smith's work, and is more closely restricted to operative surgery in its more limited sense; for instance, nothing is said of fractures and dislocations at all, except in connection with wiring the patella. As this subject is one of the live questions of the day, we are pleased to see that the opinion of our author corresponds to that of Dr. Smith, which we have already noted. He says: "In my opinion, this measure should not be employed except for other reasons than that of the existence of a simple fracture of the bone, because I do not believe that it is good surgery to expose a patient to the contingencies of suppuration, amputation, ankylosis, and even death, for the better rectification of an injury, which, at its worst, has no tendency to terminate fatally, and almost

invariably results in a serviceable limb when treated by the ordinary methods." What an enormous amount of literature the patella has been the means of creating, and what diverse views have been held in regard to the proper method of treating its fractures! Almost as much a bone of contention have been Malgaigne's hooks, as the operative treatment, and it is rather interesting at this time to note this fact, as there seems to be a tendency to return to this, as Agnew calls it, "infernal machine."

The first fifty-six pages of the book are devoted to general principles, the treatment of operation wounds, the arrest of hemorrhage, and such other preliminary information as is necessary to introduce the reader "in medias res." The consideration of operations upon the bloodvessels takes up seventy-eight pages. The ligation of arteries is carefully considered, the rules for finding the vessels, the linear, as well as anatomical guides, being carefully explained, and, in most cases, elucidated with appropriate plates. We think this section exceedingly satisfactorily treated, even better than the corresponding section in Dr. Smith's book, for the results of the ligation are given in nearly every case by Dr. Bryant, and are not by Dr. Smith. It is stated that the innominate artery has been ligated 17 times, with 2 recoveries. We presume the author would not make such a statement without authority, but a report of the second successful case has never been brought to our notice. Thomas Bryant, in the last edition of his book, says the innominate has been ligated 18 times, with 1 recovery. Statistics of operations upon the bloodvessels performed in pre-antiseptic times are not of much value now, thus 20 ligations of the radial are recorded as having been performed during the war, with 4 deaths, and 10 of the ulnar with 3 deaths, percentages which are out of all proportion to the inherent mortality of these operations, which may be said to be nothing, when they are done with proper precautions.

The subject of cerebral localization is mentioned, but too briefly to be of much practical benefit; this would seem to be an error in view of the advances made within the past year. Nerve and tendon suturing are recommended in appropriate conditions. Of all operations of surgery none have attained such absolute precision in results, with such a small mortality, as osteotomy for the cure of deformities of the limbs; thus, in about 650 supra-condyloid osteotomies for genu-valgum, only 3 fatal cases occurred as the result of the operation.

Chapters VIII., IX., and X. are devoted to operations upon bones, chiefly to excisions, resections, and amputations, which are well illustrated and correctly described, but require no special notice. Considerable space is devoted to plastic surgery, rhinoplasty, etc.; the remarkable case of Dr. Sabine is mentioned, but no cuts given. We think some of the old cuts might have been omitted, as they have been in every work upon surgery for about fifty years, but the osteoplastic formation of the nose performed by Dr. Sabine deserves more than slight notice, and is well worthy of being illustrated in a work on operative surgery. In this case, the bridge of the nose was lost, and it was restored by attaching a finger to the skin of the forehead, after removal of the nail and the denudation of the palmar aspect of the finger to the middle of the first phalanx. After union had taken place to a degree sufficient to insure vitality to the flaps, the finger was amputated about its middle, and the framework of the nose was thus secured. The soft parts of the

finger and the contiguous tissues of the face were united at the time the finger was secured to the forehead, and an organ formed which gave the man some semblance to a human being, though it did not make him an Adonis, as we happen to know from personal observation.

In speaking of the operations upon the kidneys, nephro-lithotomy is said to have been performed 6 times, with no deaths; these statistics are certainly quite ancient. Dr. S. W. Gross mentions 21 or 22 operations in his article in this journal, with 2 deaths, which makes the mortality about 10 per cent. for completed operations, and nothing for 24 cases in which an exploratory incision was made in the loin, and no stone was found. Henry Morris also gives about the same results. The author is also in error in regard to extirpation of the spleen, when he says, "it has not proved successful, however, in any instance when practised for leucocythæmia." Unless we are quite mistaken, the spleen has been extirpated for leucocythæmic tumor 20 times, with 1 recovery. It is an operation, however, which is absolutely unjustifiable for this disease; and it seems to us that the results are not very "flattering," when performed for other causes, "being in excess of 50 per cent." The author also leaves us to guess which "results" he means, as he does not state whether good or bad. Amongst the methods for radical cure of hernia is one by the author himself, and it is greatly to be regretted that the description of it is not clear and readily understood. It would also have been well if cuts of the procedure had been given.

In none of these works upon operative surgery do we find any account of the methods of Sonnenburg, Thiersch, or Trendelenburg for the cure of exstrophy of the bladder. There is an effort being made by the German surgeons to perform osteoplastic operations for the cure of this dreadful malformation, and it looks as if better results would eventually be obtained than by the ordinary operations of Wood and Maury.

Notwithstanding the few inaccuracies of statement in regard to the results of certain operations and a few other minor defects, Dr. Bryant has produced a valuable book which is fully up with the times. His views upon doubtful operations are conservative, and to our mind judicious, and his teachings may be followed with safety. The mechanical execution of the work is good, the plates and cuts accurate, and a good index is supplied. We congratulate the author upon having placed a good and useful work upon operative surgery in the hands of the profession. It is not so voluminous as Smith's work, having about 350 fewer pages, perhaps not so elaborate or so comprehensive, but it is equally as reliable, and will be almost as useful.

3. Mr. Lane's book is a condensed manual of 276 pages, which is shorn of all superfluous diction to such an extent that only the bare descriptions of the various operative procedures are left, without giving any of the indications for operation, or detailing the results which ought to be obtained. The author in his preface does not state any reason for the publication of this work, and we are left in doubt whether there is "a long-felt want" in England, which a manual of operative surgery will fill or not. The present work is perfectly reliable as far as it goes, but it cannot compare with either of the works mentioned above, and it likewise falls far below Stimson's manual of operative surgery, both in the arrangement of its contents and excellence of its figures.

We have already said that the work is perfectly reliable as far as it

goes, and to anyone who wants a book which can be easily carried in the pocket, and who does not desire to read many details, we can commend the present. The descriptions of the operative technique are good, and the anatomical explanations correct, but we do not agree with the author that it is more convenient to refresh our anatomical knowledge by a reference to the plates of Gray or Quain than to have them in the manual.

The particulars in which the work is wanting, in our opinion, are the following: too great condensation of its contents; failure to express any personal opinion as to the respective merits of various operations; the omission of various operative procedures which are now recognized the world over as legitimate, as Mikulicz's, Tripier's, and Hancock's operations upon the foot, gastro-enterostomy, and digital divulsion of the pylorus, excision of the anus, etc., methods which, though not often required, ought at least to be mentioned in a work upon operative surgery. The figures and plates are entirely too diagrammatic, and are made to do service in too many capacities. It may not be necessary to describe the methods of dressing wounds for English readers, but we think this omission an error. The dressing of a wound, the manner of introducing sutures, and the drainage are matters which are more important than the operation itself in many cases, and wherever it is necessary to instruct anyone in the performance of operations, it is equally as important that he should be thoroughly instructed in the dressing of wounds and in the use of antiseptic agents.

4. Dr. Morris's brochure professes to be "a treatise on the subject of antiseptic surgery which can be understood by beginners," but if this statement is correct we must give "beginners" credit for a very superior order of intellect, as we are sure that it will be very difficult for those who are further advanced to understand a considerable portion of it.

In the preface or "First Word" of the author, the candid statement is made that "this book is modest only in its size," a statement which is amply demonstrated by a perusal of its contents. That the author is a man who entertains strong opinions, and is not afraid to express them is very evident, but if there had been as much modesty in expression as there is in the size of the book, we think the antiseptic cause would have been better served. The cause of antiseptic surgery is exceedingly strong and is sure to prevail, and every attempt to popularize its principles and practice is laudable, but its very strength demands a simple presentation of facts rather than a rhetorical display.

Whilst, therefore, we commend the effort to diffuse a greater knowledge of the methods of antiseptic wound dressing, and of the splendid results of antiseptic surgery as compared with those of pre-antiseptic times, we must positively protest against the bombastic and metaphorical style of the present work. There is a kernel of valuable information in regard to surgical dressings, the materials of which they are made, and where they can be obtained; their cost, and the manner of using them, but it is so encased in a thick shell of verbosity, metaphor, and, in some places, incomprehensible diction that its value is very materially reduced. We may be allowed to express the hope that, when a revision of this little book is demanded, the author will prune it of personalities, anecdotes of doubtful applicability, and ambiguity of expression, and will present the very valuable subject matter in plain language, as befits a scientific communication.

R. W.

VERHANDLUNGEN DER DEUTSCHEN GESELLSCHAFT FÜR GYNEKOLOGIE. ERSTER KONGRESS.

TRANSACTIONS OF THE FIRST CONGRESS OF THE GERMAN GYNECOLOGICAL SOCIETY. Edited by DR. F. WINCKEL, President, Professor of Obstetrics and Gynecology at the University of Munich, and DR. R. FROMMEL, Secretary and Docent of Obstetrics and Gynecology, University of Munich. Leipsic, 1886.

ONLY last year was a gynecological society formed in Germany, and this volume of three hundred and fifty pages contains the transactions of the first meeting, which was held at Munich, in June, with Winckel, of Munich, as presiding officer. The society commences with a membership of sixty-eight, and among the names are to be found some of the most renowned obstetricians and gynecologists of the world. Among them the Brauns, the Veits, the Freunds, the Schwartzs, Credé, Fritsch, Hofmeier, Martin, Müller of Berne, Breisky, Leopold, Olshausen, Sänger, Scanzoni, Schauta, Schröder, and Zweifel, names familiar in this country.

The transactions of this society will be scanned with interest, as indicating the kind of work that is being done, the direction of professional labor, and the amount of progress being made in a country which has contributed so much to this important branch of medical science.

Looking over the volume, and classifying its contents, we find that of the thirty papers three are upon anatomo-physiological subjects, two upon subjects of general interest, one presenting an electro-lighted speculum, and one, which, with the discussion, occupies twenty-five pages, upon the prophylaxis of ophthalmia neonatorum. The others are equally divided between subjects purely gynecological and obstetrical, and of the latter five are devoted to the puerperal state. So great an attention to obstetrics in a society ostensibly devoted to gynecology, is another illustration of the intimate natural connection between the two branches, and suggests the inquiry whether two subjects touching each other at so many points, and so mutually inter-dependent, can be profitably separated by special societies for each.

Looking critically at the papers, their marked practical character is apparent at once, and is, indeed, their most striking characteristic. With but one exception is there any amount of space devoted to disquisitions purely theoretical. The papers are the record and presentation of practice, and of the writer's experience. The same remark may be made of the discussions, and the fact is very striking when the Cæsarean section is under consideration, from the number of members who give personal experience of an operation which is, in this country, comparatively a rare one.

We select a few of the papers, most important in regard to their practical aspects, for a very brief presentation of their contents.

The first paper is by Müller, of Berne, on the "After-treatment of Severe Laparotomies." The danger of septic infection after laparotomy is now reduced to so low a point as to approach to zero, while there yet remain the dangers from shock, hemorrhage, thrombosis and embolism, tetanus, and disturbances of the function of the bowels. To the last the paper is entirely devoted, and it should have been entitled accordingly.

Disturbed intestinal action of any degree up to complete obstruction, which has frequently resulted fatally, may be caused by exudation around the pedicle in Douglas's cul-de-sac, by adhesion of the intestines to the pedicle, to the line of incision, or by adhesion of coils to each other. For these consecutive accidents the author proposes two remedies: 1, the abandonment of the bandage in all cases in which there are extensive injured surfaces of the abdominal cavity; 2, the introduction of some substance to keep the surfaces apart until healed. Such a substance should be aseptic, harmless, unirritating, and readily removable. It must necessarily be liquid, and Müller believes he finds all the requisites in a seven per cent. solution of common salt. A case is related in which this course was pursued, followed by some severe symptoms, due, the writer thinks, to rapid absorption of a large quantity of liquid; and the paper closes with consideration of means to effect a constant flow of the fluid into and out of the abdominal cavity. Whether worth while to put in force, in every case, a complicated process for the escape of a comparatively rare accident, was not touched upon in the discussion, which gave, nevertheless, several points of much interest. Experience of the speakers plainly showed that such adhesions did not always cause any symptoms, as proved by autopsies and by second operations; also that it is not safe, in a second laparotomy, to go down through the scar of the first; one speaker having, in this way, divided the small intestine in two-thirds of its circumference. Elischer, of Buda-Pesth, and Küstner, of Jena, drew and stitched together the peritoneal edges of the pedicle, thus covering the new surface. The most important point, however, is the influence of different antiseptics in preventing these accidents, and the widely varying experience and views of individuals as to this influence. Thus, Kaltenbach, of Giessen, thinks that these accidents have diminished in frequency under his observation by a more tender toilet of the peritoneum, and by the avoidance of too concentrated antiseptics. At the same time his experience has shown that these adhesions result from circumscribed areas of inflammatory action "due to unsatisfactory asepsis," and he has observed a striking difference since he changed from carbolic acid to corrosive sublimate—1 to 6000.

"The contrast with disinfection by carbolic acid is very striking. During the time that I used carbolic acid I had two fatal cases of obstruction of the bowels in twenty-four operations, dependent upon circumscribed purulent inflammation with consequent adhesion of intestines. Since I have used corrosive sublimate I have not had a single case of this kind in fifty-four operations."

On the other side comes Saexinger, of Tübingen, with one hundred and thirty-one laparotomies, and a very careful cleansing of the peritoneum, without a case of intestinal complication. Then, again, Krukenberg, of Bonn, has observed intestinal obstruction, and attributed it to the use of a too concentrated solution of the sublimate. The number of cases and strength of the solution are not stated. He has, therefore, abandoned the use of the mercurial antiseptic, and since then has had no accident of this kind.

In direct connection with this subject comes the paper by Elischer, of Buda-Pesth, on "Poisoning by Iodoform after Severe Operation." The writer gives in detail several cases in which severe and dangerous symptoms followed the dressing of wounds with iodoform. These symp-

toms seem to have been similar to those observed by Treves[1] and described by him as acute iodoform poisoning. The cases might easily have been taken for inflammation of the meninges. There was sudden delirium with excitement and vomiting. In some cases jaundice was present and in others great depression of strength without apparent explanation. Great frequency of the pulse—140—and a pulse out of all proportion to the temperature—pulse 120, temp. normal—seem to have been almost always present. This differs from Treves's observations of a temperature rising to 104°, or even 106°. From these cases the writer believes himself justified in sounding a note of warning as to the free use of iodoform upon extensive wounded surfaces. There is no notice of any cases similar to Treves's chronic iodoform poisoning, nor is any eruption spoken of. One member, however, had observed violent itching of the skin in one case.

The discussion upon this paper is most valuable in two important practical aspects. It embraced the subject of the paper proper and also the curability and operative treatment of tubercular peritonitis. The views of the different speakers are, therefore, arranged and presented under these two heads.

In regard to iodoform poisoning it is to be observed, first, the expression of doubt as to iodoform being always the cause of the symptoms given. Slaviansky, of St. Petersburg, had seen just such a case of disturbances of the nervous system, a constantly rising pulse with a temperature not above 98.4°, and considered it to have been a case of intoxication by iodoform. The autopsy, which was thoroughly made, "gave a perfect picture of septicæmia." Battlehner saw a case of mania following and attributed to iodoform, which, after cure in an asylum, presented a recurrent attack. Chrobak had seen one case in which the symptoms given above were present when no iodoform had been used. Second, while in regard to explanation of the anomalous symptoms there were some voices in favor of that refuge of lacking knowledge, idiosyncrasy, considerable evidence was presented that fatty subjects seem more likely to be injuriously affected by iodoform. Doubtless the theoretical proposition of Chrobak is sound, that, as with ether so with iodoform, the condition of the kidneys should be carefully investigated, and that much depends upon their excretory power. Third, whatever the explanation of the origin of the toxic effects may be, abundant evidence is here adduced that these effects are altogether exceptional in occurrence and that iodoform has been used very freely, and in large numbers of cases without any injurious consequences. To the interior of the uterus it has been repeatedly applied in quantities of six to ten grammes; one speaker says bad symptoms are never caused by less than ten grammes; Chrobak always uses it freely in all laparotomies, injuries of the parturient canal, retention of portions of placenta, has used it in "hundreds of cases" and seen no bad symptoms as a consequence. The positive statement made in this country that "iodoform, in greater quantity than forty-five grains, will give rise to poisoning,"[2] seems, therefore, not to be sustained by this testimony.

The subject of the operative treatment of tubercular peritonitis was introduced by the report of two cases by Frommel, which were treated

[1] Practitioner, October, 1886. This journal, January, 1887, pp. 246, 277.
[2] Weir: Trans. N. Y. Acad. Med., vol. iv. p. 190.

by laparotomy and "thorough iodoforming" of the peritoneal cavity. Both yielded a brilliant result. During the discussion two other cases of like character were related. But that the recovery in these cases did not depend upon the iodoform was speedily made apparent. One case is reported cured in which the abdomen was sponged out with solution of carbolic acid, and another in which corrosive sublimate was used, the patient dying eight months afterward of phthisis. Two cases were cured by tapping alone, one of them undoubtedly suffering from pulmonary phthisis, which caused death a year afterward, and in one case laparotomy alone removed a very large quantity of fluid which never reaccumulated. In this case there was no part of the peritoneum as large as a small coin (pfenniggrösse) which was not studded with tubercular deposit. Of course, the question of accurate diagnosis as to the character of the deposits was not passed over. In one of Frommel's cases the "papillary excrescences" were evidently "granulation tissue," and that they are not always tubercular, was argued from Spencer Wells's case.[1] Nevertheless, the subsequent death of several of the patients from tubercle elsewhere would seem fairly to prove the nature of the peritonitis which gave rise to the ascites, and in addition the number of cases in which specimens were exsected and submitted to microscopic examination was so great as to leave no shadow of doubt as to their character, despite the position of one speaker that no diagnosis could be satisfactory where the presence of the tubercle bacillus had not been demonstrated. Further than this, it appeared from the experience of members that tubercular peritonitis is by no means the fatal disease it is generally held to be. Not only does it show "a surprising tendency to recover after operative measures," but in many cases it heals spontaneously, or may disappear for years. Two cases of spontaneous recovery are related, the patients dying afterward of phthisis.

Sänger opens a paper upon "Simplification of the Cæsarean Section," with the admission that, although with modern use of antiseptics and our increased knowledge of abdominal surgery, the "classical simplicity" of the operation has been forever left behind, yet that it has been made too complicated, and that, to be of service, its technique must not be such as to require the skill of the practised laparotomist, but must be brought within the range of surgeons in general. He therefore lays down the steps and measures of the operation which he now deems essential, as derived from larger experience. He prepares the patient as for any abdominal operation, using carbolic acid or sublimate as disinfectants, and only two assistants besides the midwife, who will care for the child, are required. The anæsthetic may be committed to a layman, a point which was justly protested against in the debate. The incision is made in the median line passing, if necessary, through the navel. The application of pressure-forceps, and the provisional sutures for drawing together the abdominal walls to prevent escape of the intestines, may be dispensed with. The turning out of the uterus before incising it is not necessary, except when the child is dead, or when sufficient assistance is not present to prevent entrance of uterine contents into the abdominal cavity. If the placenta be under the uterine incision, either cut directly and rapidly through it, or peel it off sideways as quickly as possible. In three cases he has pursued the former course once and the latter twice.

[1] Ovarian and Uterine Tumors, 1882, p 101.

The child is then extracted, and during or after this step the uterus is turned out of the abdomen, the walls of which are drawn and held closely together behind it, so as to prevent all ingress of fluids; the intestines, if escaped, covered by, and the uterus laid on, disinfected napkins; constriction of the cervical portion may be by manual compression, or "by twisting the uterus on its long axis," instead of by the elastic cord. "In the interest of simplicity," the undermining or dissection of the peritoneum, and the resection of the muscular structure of the uterus, have been abandoned. The uterine wound is closed by eight to ten deep sutures passed through everything except the decidual surface, and preferably of soft silver wire, after which from sixteen to thirty sutures of fine silk are passed through the serous membrane, twice on each side, as in the Lembert suture for the intestines. Closure of the abdominal wound is as usual, and the after-treatment "as inactive as possible." An ice-bag is placed on the abdomen as the patient is put to bed. The following are the statistics:

The total number of cases now amounts to 30, with recovery of the mother in 21—73.3 per cent; 27 children saved—90 per cent. Deducting 3 American cases, all fatal, there remain 27 cases for Germany and Austria, with 22 recoveries—81.5 per cent. At the front stands Leopold with 11 cases—10 mothers saved and 11 children. The three clinics of Leipsic, Dresden, and Innsbruck have had, altogether, 19 cases, with 18 mothers saved—94.7 per cent.; and 19 children—100 per cent.

Much of the discussion was taken up with questions of priority and on the relative value of silver and silk for the deep uterine stitches. Sänger allows either, but prefers silver, while some preferred silk, and doubted the safety of silver if the operator is not skilled in fastening it. Schauta advocated the silver suture strongly, and gave the following statistics: Of 17 cases in which silver sutures were used, not one died; while there were 7 fatal cases out of 10 in which silk was used. He justly says that septicæmia could not explain this marked difference. Priority as to Sänger's particular mode of bringing together the peritoneum was denied, but again strongly claimed by him in closing.

Leopold's remarks are of great value, from the large experience upon which they are based, and because in every case he has "sought to place himself in the position of the practitioner, and aimed to attain the greatest possible simplicity and safety of the operation as performed in private practice." He is in favor of turning out the uterus before incising it, and says that this can be done without much difficulty. He also recommends the provisional stitches through the abdominal walls in order to draw them together behind the uterus—a proceeding which he "cannot too strongly recommend." He then puts on the rubber constrictor, fastens it with a clamp forceps, and only draws it up tight after removal of the child. He does not express himself as to incising or peeling off the placenta, but other speakers expressed themselves strongly in favor of going directly through the placenta with the hand, if possible.

However much the value or novelty of Sänger's contributions to the modern Cæsarean operation may be questioned, this much was accorded him here and passed unchallenged: He has rendered the great service of having advocated the old and classic method at a time when all were marching under flying banners in support of the Porro operation. By

the extraordinary improved results of the modern method he has widened the range of application of the operation and lessened its mortality.

The operation of shortening the round ligaments for retroflexion is considered in a paper by Zeiss, of Erfurt, entitled "Zur Alexander-Adams'schen Operation." He advocates the procedure, and presents his experience of three cases modestly in view of the "cold and cautious reception given to this operation in Germany." All the three patients are thankful that he has operated upon them, but in neither of them has a year yet elapsed. The paper having opened with a criticism of some objections made by the President in his recently published work,[1] Winckel replies. His objections are purely theoretical and, therefore, such as must yield to experience; the strongest one is that sufficient time has not yet elapsed to test the results. The principal speakers besides, were Slaviansky and Mundé, of New York, both of whom present considerable experience with the operation which gives valuable testimony as to the difficulties of performing it and its results. The former has had sixteen operations; twice the ligaments were not found at all, and five or six times unsatisfactorily; when found the operation was "typical, easy, and brilliant." The latter reported seven cases, the ligaments found in three and not found in three others: in the seventh, found on one side and not on the other. As to results, they seem to be favorable so far as tested. Mundé says: "I believe the operation has a future, albeit a restricted one." Slaviansky's opinion is as follows:

"I will, therefore, only say of the Alexander operation that it is entirely justifiable for certain selected cases, and for certain forms of retroflexion, the uterus being freely movable; but it is impossible to say in advance whether the operation can be performed or not. It does not, therefore, at present stand on a very wide foundation, and much investigation is yet necessary in order to be able to say how, when, and in what cases it is practicable."

We have preferred to occupy the space at our disposal with a fair epitome of a few subjects of practical interest rather than to attempt a *résumé* of each paper which could but be unsatisfactory from its brevity, or to consider papers in which unsettled questions are discussed rather than addition made to our knowledge. For the benefit of those who may be interested in the subjects, we give the titles of the principal remaining papers, with names of the authors:

Bayer: On placenta prævia.
Fehling: On the relation between the composition of the blood of the pregnant woman and that of the amniotic fluid.
Sänger: On examination of the ureters in woman by the touch.
Winckel: On the doctrine of internal puerperal erysipelas.
Bumm: On the etiology of puerperal cystitis.
Stumpf: On puerperal eclampsia.
Runge: On the general treatment of puerperal septicæmia.
Sänger: On the relations of gonorrhœal to puerperal disease.
Schatz: On ulcers of the female bladder.
Schauta: On the operation for recto-vaginal fistula.
Küstner and Korn: On perineorrhaphy—two separate papers.
Olshausen: On the early stages of myoma clinically considered.
Küstner: On cocaine in plastic surgery.

[1] Lehrbuch der Frauenkrankheiten. Leipsic, 1886.

Finally, we can but congratulate our medical brethren of Germany on the formation of this Society, and on the excellent showing both as to quantity and quality of the first volume of its transactions. The high expectations excited by the array of distinguished names at the opening of the volume are not disappointed by perusal of its contents.

J. C. R.

SPASM IN CHRONIC NERVE DISEASE. THE GULSTONIAN LECTURES, DELIVERED AT THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, March, 1886. By SEYMOUR J. SHARKEY, M.A., M.B. Oxon., F.R.C.P. London: J. & A. Churchill, 1886.

IN the unpretentious little work, *Spasm in Chronic Nerve Disease*, Dr. Sharkey has taken a general view of the subject of muscular spasm in chronic cases, but he has also collected a fund of clinical material so illustrated with interesting and valuable observations, that he has done much to put in compact form what is now known of a very difficult problem in neurology.

There is nothing so dark in the general obscurity of nervous diseases as the study of the cause of spasm. Hence, to throw light on this branch is, indeed, a work to be commended, and Dr. Sharkey has cause to be congratulated on his selection of a subject for the Gulstonian Lectures. An investigation into the cause of spasm in organic nerve disease is at present highly interesting, in view of the mapping out of the brain into motor centres and sensitive areas, and the general localization of the functions of that organ. Dr. Sharkey divides his lectures under the following heads: (1) spasm in connection with cerebral motor mechanisms; (2) in connection with spinal mechanisms; (3) functional spasm.

In the consideration of the first division of spasms Dr. Sharkey necessarily goes into the discussion of localization of brain functions, and in describing the motor area of the cortex refers to an explanation of a long-observed clinical fact,

"that in hemiplegia, in connection with disease of the central ganglia, the arm is usually more paralyzed than the leg. For hemorrhages from the branches of the lenticulo-striate artery would, from their position, press more upon the anterior than the posterior division of the motor segment of the capsule, and this is the vessel which most frequently bleeds."

The probable explanation of this is, that the fibres of the arm in the capsule are anterior, and those for the leg lie posteriorly. Dr. Sharkey seems to doubt the exact diagnostic value of knee-jerk and ankle-clonus, etc. This spasm must be studied with regard to the condition of the patient. For instance, Dr. Sharkey says:

"A man suffering from extreme debility and anæmia came to my out-patient room, and the house physician called my attention to the fact that he not only had very extensive knee-jerks, but as marked knee- and ankle-clonus as I ever saw. He was sent into the hospital, and after two days' rest in bed I was unable to elicit even the slightest clonus."

A most interesting series of cases is given in the first lecture, showing the pathological conditions which produced tremors and spasmodic contraction of muscles. These cases are made more clear by illustrations.

In the second lecture the subject of spastic paralysis is taken up, and some very interesting pathological histories are given. In this lecture, as in the first, the connection between the cerebral system of fibres and the clinical phenomena of spasm is discussed.

The following lecture is devoted to the spinal system and the diseased conditions of that organ which produce the spasmodic contraction of muscle. A short summary of functional spasms, including histrionic spasm, writers' cramp, pianists' cramp, etc., conclude the work, which will be found to be of special interest to all those who study the nervous system or who are interested in physiological pathology. J. V. B.

THE HEALING OF ARTERIES AFTER LIGATURE IN MAN AND ANIMALS. By J. COLLINS WARREN, M.D., Assistant Professor of Surgery at Harvard University. 8vo pp. 184. New York: William Wood & Co., 1886.

DR. WARREN'S work on this subject of never-failing interest to the surgeon, though laboring under the disadvantage of following so closely on Dr. Senn's admirable paper on the same subject, will certainly attract much attention.

We find first a very elaborate and complete review of the history of the ligature. This has been so exhaustively treated, comparatively recently by a number of writers, notably by W. Griefenberger, Adamkiewicz, and Senn, that it would be difficult to present anything very new on the subject. The principal conclusions at which the author arrives, partly from numerous ligations performed on dogs and horses, partly from examination of specimens obtained from the human subject, are: First, the length of time required for complete repair—three to six months in larger arteries; second, the influence of traumatism and septic processes on the size of the thrombus, which was usually very small in aseptic cases; third, the very small part taken by the endothelium in the cicatrization; fourth, the complicated character of the healing process, a principal part being taken by a mass of granulation tissue surrounding the vessel, compared to the so-called provisional callus in fractures. This is said to invade and cause absorption of the fibres of the adventitia, causing the wall of the vessel where compressed by the ligature to expand, the granulation-tissue thus invading the lumen of the vessel. Lastly, and this is the condition which will be most freely criticised, the author claims that there is an active proliferation of the muscular cells of the media, and that these play a not unimportant part in the whole process.

With regard to the relative importance of the endothelium and the granulation-tissue formed outside the vessel, a comparison of Dr. Warren's plates with those of—*e. g.*, Raab (*Arch. f. Klin. Chir.*, 1878, xxiii. "U. d. Ent. d. N. im Blutgefäss. n. der Unterbind.")—will we feel sure go far toward convincing the reader that the differences depend on the numerous and often trifling variations in the performance of the experiment—*e. g.*, the extent of the incision, laceration or bruising of surrounding tissue, with, probably most important of all, success or failure in preserving asepsis. Dr. Warren states that in many of the experiments

no special effort was made to keep the wound aseptic, and that, as a rule, they healed rapidly in the deeper portions, but a small subcutaneous cavity was almost invariably found containing serum, muco-purulent fluid, or pus as the case might be. Occasionally a small fistula led down to the ligature, and in a few considerable suppuration took place.

Now, in the last two sets of cases always, and in the first at least very often, we are dealing with infected wounds, in which an inflammatory process, very different from mere repair, is going on, an inflammatory process which could very well account for the abundant ensheathing callus, and the extent to which the vessel wall was softened and replaced by connective tissue. It seems to us to impair seriously the value of Dr. Warren's conclusions, at least as applied to cases where no infection occurs, that some pains were not taken to avoid suppuration, or at least the presence or absence of infection noted. That in most cases suppuration did not occur around the ligature, which was generally encapsuled in the callus, will not alter matters greatly for those who have noticed the extent to which bacteria often infiltrate surrounding tissues without necessarily causing them to break down. Smooth, muscular tissue is not always easily distinguished, and the non-participation of the muscle cells in the cicatrization has been maintained by so many excellent authorities with such "singular unanimity," as Dr. Warren himself says, that one is tempted to think that there may be good grounds for such a consensus of opinion. R. J. H.

THE NATIONAL DISPENSATORY: CONTAINING THE NATURAL HISTORY, CHEMISTRY, PHARMACY, ACTIONS, AND USES OF MEDICINES. By ALFRED STILLÉ, M.D., LL.D., Professor Emeritus of the Theory and Practice of Medicine in the University of Pennsylvania, and JOHN M. MAISCH, Phar. D., Professor of Materia Medica and Botany in the Philadelphia College of Pharmacy. Ninth edition, revised and improved. Imperial 8vo. pp. xv. 1781. Philadelphia: Henry C. Lea's Son & Co., 1886.

THE National Dispensatory is so well and favorably known on both sides of the Atlantic that scarcely anything is left to the reviewer except to call attention to the fact that another edition of this valuable work has made its appearance.

This last edition surpasses even its predecessors in thoroughness and accuracy. The fact that in 1884, when the third edition was published, no revision of the British Pharmacopœia had been made for seventeen years has necessitated a thorough going over of the whole work in order that the references might correspond to the last revision of the work of our British cousins. In addition to these changes is a fairly full *résumé*, in the form of addenda, of the more important drugs which have come into general use in the last two or three years, chief among which may be mentioned antipyrin and cocaine hydrochlorate.

Professor Stillé finds an opportunity, under the headings of antipyrin and thallin, to attack once more the use of antipyretics on general principles, and the whole tone of the article on these two drugs, as well as the references alluded to, is decidedly adverse. While it cannot be

doubted that in certain cases antipyrin has produced untoward symptoms and even death, it is also a fact that considering the widespread use of this remedy comparatively few disagreeable effects have been noted.

As to the attack on antipyretics in general it can only be said, with all deference to the opinions of Dr. Stillé, that his statements are arrayed against the opinion of the profession in general in this respect, and that the daily clinical experience of an exceedingly large body of able men still leads them to the use of such drugs.

By far the fullest article on these newer remedies is devoted to cocaine. In the space of eight pages the derivation, history, and medicinal properties of this valuable remedy are quite thoroughly considered, and the drug is spoken of as "a precious discovery." The new basis for ointments, lanolin, receives favorable notice, while menthol and urethan also come in for their share of attention. H. A. H.

DE L'INTERVENTION CHIRURGICALE DANS LES AFFECTIONS DU REIN. Par AZARIE BRODEUR, M.D., Professeur a l'Université Laval a Montreal, etc. Avec cinq planches en chromolithographie et neuf figures intercalées dans le texte. 8vo. pp. 576. Paris: G. Masson, 1886.

SURGICAL INTERVENTION IN RENAL AFFECTIONS. By AZARIE BRODEUR, M.D., etc.

To anyone interested in the surgical affections of the kidney and the operations performed for their relief, this attractive-looking volume, which appears to be based upon a thesis for the doctorate, holds forth, on superficial examination, the promise of a rich intellectual treat. A careful study of its contents, however, shows that the subjects embraced in its pages have, as a rule, been imperfectly discussed, and that it should include conclusions drawn from an analysis of upward of five hundred operations that had been recorded up to the time of its appearance, instead of three hundred and twenty-seven cases collated by the author, many of which are incorrect and evidently quoted without consulting the original authority.

The operations for calculous affections are hopelessly mixed. In a table of twenty-five nephrolithotomies are included seven cases which are not illustrations of that procedure at all; while nephrotomy and nephrolithotomy are used as convertible terms for the removal of stones from pyelonephritic kidneys. In his table of forty-four nephrectomies for calculus associated with suppurative lesions, thirteen operations are recorded in which a stone was not present; while his table of nephrotomies for suppurating kidney embraces only fourteen cases, when in point of fact he ought to have collated more than ninety cases. In addition to these serious defects and omissions, he discusses the various operative procedures in four pages, so that this portion of the work is practically valueless.

In concluding this brief notice of a work that has no *raison d'être*, we take pleasure in stating that it has one redeeming feature, namely, the indications for and against surgical intervention are fairly stated, and agree, in the main, with the conclusions reached by recent writers and

operators. Thus, Brodeur teaches that nephrectomy should be resorted to only after the failure of other measures for floating, calculous, suppurating, hydronephritic, and cystic kidneys; that it may be practised for carcinoma if the general health is not impaired; and that it is indicated as a primary measure for urinary fistulæ, and sarcomatous and other tumors.

OUTLINES OF THE PATHOLOGY AND TREATMENT OF SYPHILIS AND ALLIED VENEREAL DISEASES. By HERMAN VON ZEISSL, M.D., late Professor at the Imperial Royal University of Vienna. Second edition, revised by MAXIMILIAN VON ZEISSL, M.D., Privat-Docent at the University of Vienna. Authorized edition; translated, with notes, by H. RAPHAEL, M.D. 8vo. xii. pp. 402. New York: D. Appleton & Co., 1886.

THESE outlines of Zeissl's are too modestly named, for his work is a most full and detailed one, and leaves but little for such filling up as might be proper if his subject were dealt with only in outline. Certain critics have remarked that the part devoted to pathology is disproportionately large, and that in which treatment is discussed disproportionately small. We do not concur in this criticism. The fact is, that while there is still room for much debate as to the exact nature of the different venereal diseases—although we have settled convictions in regard to this matter—there is not much room for discussion as to the best methods of treating them.

Zeissl is a dualist, and in his Introductory states briefly and clearly the reasons which to him (and to us) seem to establish conclusively the essential difference between syphilis and other venereal diseases, namely, the venereal ulcer and gonorrhœa. Gonorrhœa Zeissl calls "venereal catarrh," and the venereal ulcer he calls "*schanker*," in his own tongue; or "chancroid," borrowing the French term. We regret that the translator of his work has made use of the term "soft chancre" for the German term "schanker," since we have frequently occasion to observe that, what might seem so innocent, leads to confusion in the minds of those who are not perfectly familiar with the history of modern opinions in regard to venereal diseases. Another error of the translator consists in his translation of the German term "*sklerose*" by "sclerotic ulcer." He is, of course, aware that neither sclerosis nor ulceration is conclusive as to the nature of a venereal lesion, and that the more of the one there is, the less there will be of the other. Many writers in our own language have settled upon the term "initial lesion of syphilis" as the most unequivocal one to apply to what it describes, and we hope that their example may be followed when another edition of the work we are reviewing appears.

We have no space to speak in detail of the teachings of Zeissl in regard to the different manifestations of the venereal diseases, although we may express some surprise that the section devoted to the site and form of the "Hunterian induration" (an ill-chosen term for the initial lesion of syphilis) makes no mention of the urethra. Zeissl has come to the conclusion that extirpation of the initial lesion of syphilis, however

early performed, does not prevent the outbreak of later manifestations, and he doubts whether the earliest possible cauterization is of any use.

In regard to the treatment of syphilis, we note that Zeissl considers expectant treatment as suitable to all "recent cases of acquired secondary syphilis," as well as to all cases in which a febrile disease supervenes. If the phenomena of the secondary period resist expectant treatment for eight or ten weeks, treatment with iodine may be commenced, and this is applicable to *all phases* of syphilis. In fact, relapses occur less frequently after an early treatment with iodine than after the use of mercury. Of the preparations containing iodine, the iodide of sodium and the iodide of iron are the best. The latter is especially suited to anæmic cases. Iodoform is also useful in some cases.

We call attention to this point because it has appeared to us that the opinion that iodine is adapted to the treatment of the earliest stages of syphilis, has not secured the practical assent of English- and French-speaking medical men which it deserves. It does not seem to be generally known that Sigmund, in his later years, came to reverse the old theory that mercury was the best remedy for early syphilis, and iodine for its later stages. We are glad to observe that Zeissl states that "Too much stress cannot be laid upon the fact, that even in the gravest forms of syphilis the preparations of iodine alone will often be found sufficient." And, again, "The preparations of iodine are adapted to all forms of syphilitic disease." And, as to mercurials, he says: "The mercurials generally accomplish more if they have been preceded by a course of treatment with iodine."

With this we must close our review. Zeissl's work does not need more praise than it has long since received. As the result of an enormous experience, and of a most thorough study of the subject of venereal diseases, it is invaluable to every syphilographer, and its practical teachings ought to be familiar to every one who undertakes the treatment of venereal diseases.

As a book, this translation is a credit to the publishers, and in the main to the translator. We would suggest, in addition to what has been said above, that it would be an improvement if the prescriptions were translated into the terms of our U. S. Pharmacopœia, and, even if this were not done, that they should be put into correct Latin.

C. W. D.

A Treatise on the Diseases of the Nervous System. By William A. Hammond, M.D., Surgeon-General U. S. Army (Retired List), etc. With one hundred and twelve illustrations. Eighth edition, with corrections and additions. New York: D. Appleton & Co., 1886.

The fact that an eighth edition of Dr. Hammond's work has been called for is sufficient proof of its standing in the American profession, but when the preface of the seventh edition calls attention to the fact that it has been translated into French, and that an Italian translation was at that time going through the press, it is very evident that the first systematic treatise on nervous diseases published in America has commanded decided attention abroad.

Certainly, in point of lucid arrangement and classification, Dr. Ham-

mond's work is an admirable treatise on an important special branch in medicine, and its popularity shows what a demand there is for it both by students and active practitioners. Whatever work may have been done before, and whatever names may have been known in England and on the Continent as prominent in this special branch of medical research, Dr. Hammond was the first in America to collect the material for a systematic work on the diseases of the nervous system, and he performed his task so cleverly that his book, after passing through eight editions, remains practically the same to-day as it was when the plan of it was first conceived. It contains the same classifications and divisions, amplified by fuller knowledge, and made more valuable by the observations of many of his co-laborers in neurology.

Dr. Hammond's book has been so often and so favorably reviewed that it will be unnecessary in the present notice to consider any other than the new portions of the edition. Before, however, referring to these sections, it is due to Dr. Hammond to allude briefly to some important observations which are to be found in the older portions of this treatise.

The term neurasthenia which is so prevalent, and of which most neurologists are so thoroughly tired, is not mentioned, and all symptoms usually included under that head are classed as cerebral congestion. The line of division between some cases of mild melancholia and so-called cerebral congestion is so indefinite that it would seem necessary to describe an intermediate condition which would include the abdominal symptoms of these cases, and especially the series of marked sensations which seem to arise from some disturbance of the abdominal sympathetic system. Exophthalmic goitre is very appropriately included under cerebro-spinal diseases, and the description of this remarkable trouble is both graphic and instructive.

Dr. Hammond still adheres to the consideration of athetosis as a distinct disease, though most observers will agree with Charcot that it is simply a symptom of certain forms of hemiplegia. Any disease of so complicated an organ as the brain must necessarily show many anomalies, and this anomalous consequence either of paresis or paralysis can never be traced as a distinct disease.

Convulsive tremor is the name given in this work to a class of peculiar cases which border between hysteria and epilepsy, and to which Dr. Hammond has been among the first to call attention. No one who has met these obscure and puzzling cases can fail to be thankful for an account of this disease, however imperfect or unsatisfactory it may be. The fact that such conditions may be cured, or, to state it more correctly, may recover can be attested by the writer of this review. Yet any one of limited experience, who is unacquainted with the observations contained in the chapter now under consideration, would be led to think that a favorable result in convulsive tremor is neither possible nor probable. Only lately a case of convulsive tremor has come under the writer's notice which was diagnosticated by a neurologist as one of brain tumor, and death was predicted in a few months, yet the patient improved under appropriate treatment, and progressed within a year to entire recovery.

In the present edition a new section is added on "Certain Obscure Diseases of the Nervous System." Of these diseases, Dr. Hammond says: "Under this head I propose to consider certain affections obviously due to derangement of the nervous system in some one or more of

its parts, but which are only known by their symptoms, there being no definite knowledge relative to their exact seat, nor in regard to the essential nature of the existing disturbance." The diseases claiming consideration in this section are tetany, Thomsen's disease, and miryachit, and kindred affections. The first two, though well known, are certainly obscure, but to see this last it seems necessary to travel far, for Dr. Beard went into the wilds of Maine to find the jumpers, and Lt. McLean, of the U. S. Navy, made his observations of miryachit in northern Siberia, and a French observer has noticed a similar morbid condition among the Malays, which is called in that country Latah.

Dr. Hammond says of these curious "nervous manifestations:"

> "I am not able to give any certain explanation of the phenomena of 'miryachit,' or of the 'jumpers,' or of certain of these cases of sleep-drunkenness, which seem to be of like character. But they all appear due to the fact that a motor impulse is excited by perceptions without the necessary concurrence of the volition of the individual to cause the discharge. They are, therefore, analogous to reflex actions, and especially to certain epileptic paroxysms due to reflex irritations. It would seem as though the nerve-cells were very much in the condition of a package of dynamite or nitro-glycerine, in which a very slight impression is competent to effect a discharge of nerve force. They differ, however, from the epileptic paroxysms, in the fact that the discharge is consonant with the perception—which is, in these cases, an irritation—and is hence an apparently logical act, whereas in epilepsy the discharge is more violent, is illogical, and does not cease with the cessation of the irritation."

Dr. Hammond has also added to his treatise by incorporating in it the appendix of Dr. Labadie-Lagrave, which was added to the French translation of a former edition of this work.

The section on "Diseases of the Sympathetic Nervous System" is, with the exception of a few notes in brackets, drawn entirely from this source.

The sections on "Cerebral Syphilis" and the "Symptomatology of Cerebral Lesions" are also translated from the work of Dr. Labadie-Lagrave. The last chapters of the section on "Cerebral Lesions and Cerebellar Diseases," including copious annotations by Dr. Hammond, are probably the most lucid explanations of these subjects that we can find in any general treatise on the nervous system.

A translation of "Conclusions Concerning the Diagnosis of Diseases of the Brain," contained in Nothnagel's work *Topische Diagnostik der Gehirnkrankheiten*, is appended to this section, and these formulated symptoms, together with the preceding chapters, make a most interesting *résumé* of what is now known on the subject of localization of brain lesions. This branch of neurology is now attracting so much attention, and in some directions making such signal progress, that the author has certainly added much to the value of the book by making the discussion of the subject as full and comprehensive as the limits of a general treatise would allow.

Of the numerous works on diseases of the nervous system that have appeared in the last few years, it is not too much to say that Dr. Hammond's is the best in many ways: it is very practical, the style is clear and precise, the descriptions are graphic, and treatment is full and satisfactory. During the fifteen years that the book has been before the profession, much progress has been made in neurology. Many changes have been made, but this last edition will be found to be carefully revised, and fully abreast with the times. J. V. B.

QUARTERLY SUMMARY

OF THE

PROGRESS OF MEDICAL SCIENCE.

ANATOMY.

UNDER THE CHARGE OF

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On the Abductor Minimi Digiti Pedis, and the Abductor Ossis Metatarsi Quinti Muscles.

Wenzel Gruber found the abductor ossis metatarsi quinti in 9.25 per cent. of 400 feet, a frequency which is much below that recorded by Wood from the examination of a smaller number of specimens. Gruber makes a distinction, however, between this muscle and the insertion of a slip of the abductor minimi digiti into the fifth metatarsal bone; the latter occurred in 8 per cent. of 350 feet; in one instance the two existed together. A new variety of this muscle is described under the name of *abductor ossis metatarsi quinti circumflexus*, the whole or a part of the tendon winding from the plantar to the dorsal surface of the fifth metatarsal bone in front of the tuberosity, to be inserted into the base of the fourth and fifth metatarsals; it was found in 3.5 per cent. The abductor minimi digiti had a slip of origin from the tuberosity of the fifth metatarsal bone in 6 per cent. A bursa was present between the tendon of the abductor minimi digiti and the tuberosity of the fifth metatarsal in 2.5 per cent. The abductor ossis metatarsi quinti is seldom absent in mammals.—*Virchow's Archiv*, December, 1886.

On the Ophthalmic Artery.

F. Meyer was led to investigate the anatomy of the ophthalmic artery by the occurrence of a case of fatal hemorrhage after enucleation of the eyeball. In the orbit which had been the seat of operation, he found the ophthalmic trunk given off from the internal carotid artery and passing into the cavity by the inner end of the sphenoidal fissure, while the lachrymal and supraorbital arteries arose together from the middle meningeal and entered the orbit through the outer part of the same aperture. The supraorbital artery anastomosed with the ophthalmic above the optic nerve. The ophthalmic artery was closely applied to the optic nerve, with which it had been divided.

The detailed arrangement in twenty dissections is given, and the general results of the investigation are as follow:

The number of the named branches, and the order in which they arise are subject to many variations, but the typical arrangement may be thus stated: (1) the central artery of the retina, arising in common with one of the ciliary trunks, more frequently the internal; (2) the external ciliary trunk; (3) the lachrymal artery; (4) a supero-external muscular branch; (5) the supraorbital, giving off the posterior ethmoidal; (6) an infero-internal muscular branch; (7) the anterior ethmoidal artery; (8) the terminal division into palpebral, frontal, and nasal. The posterior ethmoidal artery is sometimes wanting, and the supraorbital is often very small.

In addition to the branches usually described, small offsets are sent forward from the beginning of the ophthalmic artery, or from the internal carotid, to the sheath of the optic nerve; and these anastomose with other recurrent vaginal branches of the ophthalmic trunk; a similar anastomosis is formed by the small branches of the carotid and ophthalmic arteries through the inner end of the sphenoidal fissure.

Deviations from the usual condition in the origin and course of the artery are to be explained by the excessive development of a regular anastomotic channel. Thus, the artery (or an accessory source of supply) may arise from the internal carotid, and enter the orbit through the inner end of the sphenoidal fissure by the enlargement of the above mentioned anastomosis, or from the middle meningeal, infraorbital, or anterior deep temporal artery by means of the normal communication with those vessels.

The ophthalmic artery was found crossing beneath, instead of over the optic nerve in three of the twenty dissections, these numbers being identical with those obtained by Zuckerkandl. This condition may be due to an enlargement either of the anastomosis along the nerve, or of a communication between muscular branches of the trunk. In these cases the normal trunk may either disappear, or it may persist as an anastomotic loop above the nerve, which is then surrounded by an arterial ring.

In one instance the ophthalmic artery was seen passing inward above the superior oblique muscle.—*Morphologisches Jahrbuch*, December, 1886.

On the Primary Optic Centres.

The late Bernhard von Gudden was the first to show, by means of degeneration experiments, that the inferior quadrigeminal and internal geniculate bodies do not give origin to optic nerve-fibres; and his conclusions, which have been confirmed by Fovel and von Monakow, are generally accepted, although they have been, so far as relates to the inferior quadrigeminal body, recently controverted by Bechterew. L. Darkschewitsch now goes further and states, as the result of histological research in the rabbit and dog, that not only do no optic fibres spring from the above mentioned nuclei, but that the same is the case with regard to the pulvinar of the optic thalamus and the external geniculate body. The atrophy of these parts after enucleation of the eyeball is explained as due to the degeneration of nerve-fibres which simply pass through them on their way to the surface. The optic fibres have therefore only one centre, namely, the superior quadrigeminal body, but they are

joined in the neighborhood of the external geniculate body by others which spring from the pineal gland and the habenular ganglion, and which appear from physiological experiments to be pupillary fibres. Charcot's hypothesis of a crossing of the optic fibres in the corpora quadrigemina finds no support. Darkschewitsch also finds that the upper quadrigeminal body alone is connected to the cerebral cortex by a distinct tract of fibres, and that no such tracts can be followed to the outer geniculate body or pulvinar.—*Archiv für Anatomie*, August, 1886.

On the Minute Anatomy of the Brachial Plexus.

W. P. Herringham gives (*Proc. Royal Society*, No. 243, 1886) the results of 55 dissections of the brachial plexus, 32 fœtal and 23 adult. The sources of the several muscular and cutaneous branches are as follows: the numbers 5 to 8 indicating the corresponding cervical nerves, and 9 the first dorsal.

Posterior thoracic, 5, 6, and usually 7. Suprascapular, 5 and sometimes a small root from 6. Anterior thoracic, 6, 7, 8, and 9. Coraco-brachialis, 7, the rest of the musculo-cutaneus from 5 and 6.

Median, 6, 7, 8, and 9; 6 supplies pronator teres, flexor carpi radialis, superficial thenar muscles, and radial finger or fingers; 7 supplies flex. sublimis, occasionally ant. interosseous, palmar cutaneous, and the finger next to 6; 8 supplies flex. sublimis, ant. interosseous, and fingers internal to 7; 9 goes only to ant. interosseous.

Ulnar, 8 and 9; the forearm muscles are supplied by both, the hand muscles by 8, palmar cutaneous branches, 9; dorsal, 8. Internal cutaneous, large and small, 9, the large occasionally also 8.

Subscapularis, 5 and 6; teres major, 6 and often 7; latissimus dorsi, 7 and often 8. Circumflex, 5 and 6; deltoid from both; teres minor, 5 only; cutaneous branch, 5 or both. Musculo-spiral, 6, 7, and 8, sometimes also 5, rarely 9; triceps, 7 and 8, outer head sometimes 6 as well; internal cutaneous branch, 8; short external cutaneous, 6; long external cutaneous, 7; radial extensors, 6, or more frequently 7; radial nerve, 6, or 6 and 7; posterior interosseous, 7, sometimes also 8.

The following laws relating to nerve supply are also formulated:

I. Any given fibre may alter its position relative to the vertebral column, but will maintain its position relative to other fibres.

II. *a.* Of two muscles, or of two parts of a muscle, that which is nearer the head end of the body tends to be supplied by the higher, that which is nearer the tail end by the lower nerve.

b. Of two muscles, that which is nearer the long axis of the body tends to be supplied by the higher, that which is nearer the periphery by the lower nerve.

c. Of two muscles, that which is nearer the surface tends to be supplied by the higher, that which is further from it, by the lower nerve.

III. *a.* Of two spots on the skin, that which is nearer the preaxial border tends to be supplied by the higher nerve.

b. Of two spots in the preaxial area, the lower tends to be supplied by the lower nerve, and of two spots in the postaxial area, the lower tends to be supplied by the higher nerve.

PHYSIOLOGY.

UNDER THE CHARGE OF

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Electric State of the Heart on Vagus Stimulation.

A. Taljanzeff (Moscow) found in the frog and rabbit, with a modified Lippmann's capillary electrometer, that the heart gave no signs of change in its electric state during the stand-still produced by stimulation of the vagus, comparable with the electric changes characteristic of muscle contraction.—*Archiv Anat. und Physiol.—Physiol. Abthl.* Supplement Band, Dec. 1886.

Electric Change in the Heart Accompanying Stimulation of the Vagus.

In support of his view that all tissues are innervated by antagonistic (anabolic and katabolic) nerves, Dr. W. H. Gaskell brings forward the observation that stimulation of the vagus in the neck of the tortoise causes in an uninjured portion of a strip of the quiescent auricle, when connected with the rest of the animal by the coronary nerve alone, a decided increase of electric *positivity*, just as a contraction is accompanied by a decided increase of *negativity*.—*Journal of Physiology*, Nov. 1886.

Rhythm of Voluntary Movement.

Prof. J. von Kries (Freiburg) made observations in control of the results obtained by Schäfer and Horsley (see last number of this journal, p. 217), and in the main confirms their views. He considers all voluntary contraction of muscle to be of a tetanic nature. Volition never works with a single but always with a series of excitations; the shortest movement not being accomplished without some four or five. The limits in the rate of stimnlation are, however, very wide, since the rhythm of vibration is found to vary between eight and forty per second.—*Archiv f. Anat. und Physiol.—Physiol. Abthl.* Supplement Band, Dec. 1886.

Regeneration of Smooth Muscle.

Drs. H. Stilling and W. Pfitzner, doubting the accuracy of Jakimowitsch's researches on the frog and spotted salamander, investigated this question on the muscular wall of the stomach of the Triton tæniatus and conclude: 1 That organic muscle tissue can regenerate itself. 2. The regeneration takes place by a multiplication of the existing muscle-cells by division of the contractile substance. 3. This division consists of a thinning of the cell about the centre of its length after the nucleus had shown the various phenomena of karyokinesis.—*Arch. f. Microscopische Anat.*, Dec. 9, 1886.

Plethysmographic Research on Vasomotor Agencies.

Regarding the temperature of a limb as an inadequate guage of its vasomotor variations, Prof. H. P. Bowditch and his assistant, J. W. Warren (Harvard Medical School), made a series of experiments by the plethysmographic method on the vasomotor changes in the hind limb of cats following injection of curara and stimulation of cut end of the sciatic nerve. The greater or less volume of the limb was taken to indicate a more or less dilated state of the bloodvessels.

Curara lessened the size of the limb (*i. e.*, was followed by local vasomotor constriction) if the nerve were cut. The opposite result followed if the sciatic nerve were intact. These facts may be explained by supposing that a general vaso-dilator effect was caused by the drug influencing the centre from which the sciatic was cut off.

Stimulation of the peripheral end of the cut sciatic nerve of the curarized animal was followed by one of three results, viz.:

1. Prompt contraction, followed by more lasting dilatation.
2. Prompt contraction without marked dilatation.
3. Slow dilatation not preceded by contraction.

Of these the first was the most frequent.

It thus appeared that stimulation produced two antagonistic effects upon the bloodvessels of the leg. The first of these, *constriction*, is well marked with rapid stimulation, while a slow rate of stimulation favors dilatation. Owing to the rate of development of the two effects, the antagonistic influences produce their results in succession.

When the nerve had been some four or five days cut, the constricting influence was destroyed and stimulation only caused dilatation, from which it appeared that as a nerve degenerates after section it loses its constricting earlier than its dilating power, or, in other words, vaso-constrictor fibres degenerate more rapidly than vaso-dilators.—*Journal of Physiology*, Nov. 1886.

Pepsinogen and Pepsin.

Confirming results obtained by the first author, Messrs. J. N. Langley and J. S. Edkins (Physiol. Lab., Cambridge) find that pepsin is rapidly destroyed by alkalies and alkaline salts. Strength of the alkali solution, suitable temperature, and long period of action, increase the destructive power, while the presence of proteids lessens the rate of destruction.

In the hungry animal the mucous membrane of the stomach contains no pepsin, but only pepsinogen, the forerunner of pepsin, because one per cent. of sodium carbonate destroys little of the efficacy of the watery extract of the fresh organ.

Pepsinogen is rapidly converted into pepsin in the presence of weak acid, but otherwise is fairly stable, and in glycerine extract may remain unchanged for years. The change from pepsinogen to pepsin takes place rapidly during digestion.

CO_2 destroys both pepsinogen and pepsin; the former more rapidly. They are also both destroyed by a temperature of 55°–57° C.—*Journal of Physiology*, November, 1886.

The Influence of Venous Congestion on the Secretion of Urine.

Dr. Josef Paneth, working under Heidenhain, gives some evidence upon this subject, made so important by the causal relation of cardiac and renal disease. After a careful review of the literature of the subject, he describes his experiments in detail. These lead him to conclude that, besides giving rise to albuminuria, the least congestion of the renal veins, under all circumstances, is followed by a diminution in the amount of the secretion, and that an increase of the secretion of the kidney cannot follow venous congestion. From the fact that the injection of diuretic salts (he supposes by raising the blood-pressure in the glomerules) causes reappearance of the flow when it had ceased from venous congestion, the author concludes that Heidenhain's hypothesis as to the mechanism of the cessation of secretion is correct, viz., that it depends on the lessening of the rate of the blood stream in the Malpighian capsules, and not, as Ludwig supposed, on the mechanical compression of the canals by the congested state of the veins, which condition remains unaltered or is increased by the greater flow through the glomerules.—*Arch. f. Gesam. Physiol.*, December 10, 1886.

Periodic and "Luxus" Breathing.

In an elaborate paper, illustrated with many tracings, Prof. Angelo Mosso, of Turin, gives the results of research on the respiratory movements of man and animals. He points out that a periodicity in the respiratory rhythm is much more common than is generally supposed, and can be produced by ordinary sleep or the action of narcotics. Under ordinary circumstances, the respiratory movements are more extensive and rapid than required by the organism. This "luxus respiration" disappears at high altitudes when the air becomes thinner. When the degree of periodicity becomes more marked, the breathing may be called remittent or intermittent, as in the Cheyne-Stokes respiration. In a dog under the influence of chloral hydrate, the inhalation of oxygen had no effect on the duration of the periodic intervals of cessation of breathing. He considers the view that a continuous relationship between the chemistry and the mechanism of respiration must be abandoned. The different departments of respiratory motion, facial, thoracic, diaphragmatic, etc., are capable of independent action or variation. Although not quite independent, yet the mechanisms of respiratory movement are so far automatic as to be able to surpass the chemical requirements of the organism, the vitality of which is indicated by the activity of the regulating nervous centres. Thus when the excitability of the brain and spinal cord increases, a greater gas-interchange occurs in the lungs than is necessary for the activity of the body, and during sleep the motor mechanisms of respiration indulge in periodic rests, and nervous excitation is lessened without the result of any interference with the chemical changes in the tissues or blood. The periods of variation in the respiratory movements do not correspond with those in the bloodvessels. If a variation be caused during the regular breathing, it is followed by a series of successive variations occurring periodically.—*Archiv f. Anat. und Physiol.* Supplement Band, December, 1886.

Innervation of Respiratory Movements.

In an exhaustive paper with extensive literary reference, Dr. Max Marckwald (Kreuznach) gives a number of original experiments, in which the movements of the diaphragm are graphically recorded by the direct application of the flattened end of a lever to the under surface of the muscle, through a small opening in the abdominal wall. Among the conclusions to be arrived at, may be mentioned the following:

No respiratory centres can be said to exist above the medulla oblongata, where an easily excited *inspiration-centre*, acting in normal breathing, and a more difficultly excited *expiration-centre*, acting in dyspnœa, are situated.

Automatically the centre can only give rise to respiratory spasms, regular and rhythmical breathing being reflex acts, excited by the tonic action of the vagi in quiet respiration.

Impulses from the higher centres can also reflexly excite regular respiratory movements controlling or compensating those produced by the vagus. When these impulses from the higher centres are partially in abeyance, while the action of the vagus is unimpaired, periodic breathing (Cheyne-Stokes) may appear. Impulses from the skin have probably little effect while the vagal and cerebral channels are intact; but when these are interfered with, the sensory nerves may excite a regular series of respiratory movements.

The afferent fibres of the fifth, superior laryngeal, olfactory and splanchnic nerves slow respiration, and may cause standstill in the position of expiration. The glossopharyngeal do not alter the rate, but can produce slow inhibition.

The normal excitation of the respiratory centre does not depend upon the stimulation of the blood—either its want of oxygen, or excess of carbonic acid—as regular movements continue for some time without circulation; nor can the mechanical theory—the excitation depending on the degree of distention of the lungs—be accepted, as rhythmical movements continue when the thorax is opened and the lungs excised.—*Zeitschrift f. Biologie*, N. F. Bd. v.

MATERIA MEDICA, THERAPEUTICS, AND PHARMACOLOGY.

UNDER THE CHARGE OF

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Lobeline.

From advance sheets of the *Drugs and Medicines of North America*, for which we are indebted to Prof. Lloyd, we obtain the investigations of Dr. Bartholow on the actions and uses of lobeline—the alkaloid of *Lobelia inflata*. Several papers have appeared on the physiological actions of lobeline, but up to the present there have been published no reports on its clinical

uses. Lobelia, the crude drug, has been the subject of no little controversy, and much has been said of its practical applications, but wholly from the empirical standpoint.

Lobeline is a liquid alkaloid of a brownish-red color, and it has an acrid taste and a tobacco-like odor. The salts are crystalline, and are freely soluble. The preparation used by Dr. Bartholow in his physiological and clinical research was a solution of the hydrobromate, furnished him by Prof. Lloyd.

In general terms, lobeline is a paralyzer, causing death by failure of respiration. Small doses at first increase the irritability of the reflex centres, and the cutaneous and corneal reflex are considerably exaggerated. As the action proceeds the paralysis beginning at the periphery increases, until finally complete muscular resolution occurs. The end organs of the motor nerves are first affected, then the nerve trunk, and finally the cord; but the muscles preserve their contractility. The pneumogastric terminals are paralyzed, and the heart, after a brief slowing, increases in movement considerably. If the medulla be first divided, when the full effects of lobeline are obtained the heart is arrested in the diastole, its cavities distended. If now a faradic current is applied, the auricle will start in action, but only the basal portion of the heart, and the latter acts much more feebly than the former. As the effects of lobeline develop, and before full paralysis occurs, the vasomotor centre is stimulated somewhat, and the blood-pressure rises a little; but it subsequently declines. Lobeline does not paralyze the heart muscle, and death is due to respiratory failure.

As respects sensibility, there is no action, for the sense of pain is manifested until full paralysis occurs. Locally it has a benumbing effect on the mucous membrane, but this is due to physical conditions, and is not a special endowment of lobeline. Consciousness is preserved until carbonic acid narcosis ensues.

Lobeline appears to be too harsh and depressing to be utilized as an emetic. In the ordinary medicinal doses it does not usually nauseate. One subject, an epileptic, complained of nausea after several days use, but it seemed to be transient. Based on the physiological actions it was tried in various neuroses. As it is not depressing to the heart, it was used in some cases of cardiac asthma, when with difficult breathing there was a rather feeble state of the cardiac action. In this condition, and in pseudo-angina pectoris, it was found to be very useful. Asthma—the neurosis—has been the malady above all others in which lobelia has proved useful. The alkaloid seems to be superior to the crude drug.

It has also proved useful in coughs, especially when they are of a spasmodic character; and as they are necessarily reflex, an agent that lessens the activity of the reflex centres must do good to some extent. Lobeline appears to be an effective remedy as an expectorant so-called.

It has also been used with benefit in epilepsy, chorea, and the spasmodic neuroses generally; but a longer experience is necessary to determine its real value. It can be said only that thus far it promises well.

The dose of the salts of lobeline will vary from $\frac{1}{100}$ gr. to $\frac{1}{10}$ gr. It does not appear to be as actively toxic as nicotine.

Carbonic Acid Inhalation and Rectal Injection.

One of the most remarkable revivals in a therapeutical method that has happened lately, is the administration of carbonic acid gas by inhalation and by rectal injection. The proposers and advocates of this practice apparently suppose it to be a new discovery, or, at least, a novel expedient. So far from being new, it is distinctly a revival of an old suggestion—for Priestly, in his treatise entitled *Experiences of Different Kinds of Air*, alludes to the use of carbonic acid gas by inhalation in phthisis, and Percival (1768), on the *Use of Fixed Air*, proposed its administration by rectal injection. In a recent paper (*Bull. Gén. de Thérap.*, January 15, 1887) Dr. M. Dupont advocates the method of inhalation as more efficient than the rectal injection. If sulphydrogen gas is to be administered, rectal injection may be necessary, for, as Bernard demonstrated, this gas, when thrown into the rectum, escapes by the lungs, and does not act on the nervous centres; but carbonic acid gas which is mixed with the former is the active agent, and, as Dr. Dupont shows, this is more conveniently, as it is more rationally, employed by inhalation, and the results are not less excellent.

Dr. Dupont has used about 150 litres in twenty-four hours. He finds that the gas is antiseptic, and hence is appropriate in the treatment of the septicæmia of tuberculosis; that it is anæsthetic, and hence quiets the cough, allays the irritability of the larynx, and favors sleep; that it lessens waste by checking oxidation, and thus lowers the temperature; and that it stimulates the digestive organs and increases the peristaltic movements of the stomach and intestines.

Alcohol in Acute Febrile Diseases.

In the course of his "Therapeutical Conferences," now publishing (*Bull. Gén. de Thérapeutique*, January 15, 1887), Dujardin-Beaumetz advocates the use of alcohol in accordance with the principles of the great English clinician, Dr. Todd. He observes that, although the first enthusiasm aroused by the theories and observations of Todd has somewhat subsided, there is a general recognition of the great advantages of the alcoholic medication. The indications for its use in fevers are the adynamic state, the extremes of life, and habitual use.

After careful study of the physiological action of alcohol, Dujardin-Beaumetz concludes that it acts in some respects as a tonic, as an aliment, and as an antipyretic—thus formulating an opinion by a combination of the various theories most entertained at the present time. It is an aliment because it undergoes in the organism a more or less complete combustion; it is an antipyretic because the oxidation of the alcohol takes place at the expense of the oxygen of the blood, and thus lessens the production of heat; and it is a tonic because it furnishes the nervous system the elements of force and power.

The principles and methods of Todd, so recently discussed and approved in France, are surely fallen into neglect—into positive oblivion, indeed, on this side of the ocean. They were warmly approved by a section of the medical profession twenty-five years ago, but now the actively stimulating treatment of febrile diseases is relegated to the domain of past errors.

Hypnone.

In the *Archives de Neurologie* for January, 1887, *acetophenone* is the subject of a critical paper by MM. A. Mairet et Combemale, based on physiological and clinical researches. Under the name *hypnone*, by which it is now generally distinguished, and which was given it by Dujardin-Beaumetz and Bardet, who were the first to study its physiological actions (*Bull. Gén. de Thérap.*, Nov. 1885; also, *Ibid.*, January, 1887), it has been administered a good deal, but chiefly in France. Dujardin-Beaumetz and Bardet assigned the name *hypnone* because this word is significant of its most important property. Unfortunately, the new remedy, brought forward with no little *eclat*, has not confirmed the confident promises of its projectors. For the most part, it has proved to be inefficient, although not devoid of hypnotic action.

The researches of MM. Mairet et Combemale confirm the opinion of those who hold that *hypnone* is possessed of but feeble hypnotic property. They ascertained that the quantity required to produce sleep in animals is really toxic. Administered in toxic doses they say that it rapidly induces a comatose state which has nothing in common with natural sleep. It is, also, a cardiac and respiratory paralyzer, this effect coming on with the coma. Their clinical observations were made on twenty-two subjects of various mental disorders, the special conditions for which hypnone was prescribed being restlessness and insomnia. In only two cases was a hypnotic action obtained, and in these it was indirect; by allaying unrest and muscular agitation the disposition to sleep was favored.

The facts demonstrate, say they, that hypnone is not a hypnotic, and the physiological investigation gave negative results, as had been the experience of other investigators.

Clinical Experiments with Antifebrin.

Riese reports (*Centralblatt für die Therapie*, January, 1887) the results of the use by Professor Fürbringer of antifebrin. It was administered in 30 cases: 10 of acute rheumatism; 5 of typhoid; 2 of pleuritis; 4 of croupous pneumonia, and 9 of phthisis. At first the doses did not exceed 30 grains, but they were increased to 45, to 60, and in 1 case to 120 grains, without any toxic action of consequence. The date and degree of the decline in temperature were not uniform. As in the cases of acute rheumatism the temperature was only slightly elevated, the reduction effected by the remedy was inconsiderable. In typhoid, also, it influenced the fever but little, and in only one case was the diminution of fever maintained longer than the immediate action of the remedy. Very considerable variations were observed in the degree of antipyretic effect in different individuals, especially in the phthisical cases.

The slowing of the pulse corresponds to the decline of temperature. An increased tension of the arteries was usually witnessed. The respiration was also slowed, and lessened in volume, and occasionally some cyanosis of the face and extremities was observed. It never induced dizziness and headache, and, unlike antipyrin, did not cause nausea and vomiting; but, in some instances, improved the appetite. Perspiration was a constant attendant on

the decline of temperature, and, when large doses had been administered, it was excessive. In three instances alarming chills accompanied the rise in temperature, and were followed by weakness.

As regards the results obtained from the use of antifebrin, it did not have a specific effect in any of the maladies, except in acute rheumatism. It neither shortened nor modified the violence of typhoid: the cases of pneumonia did no better than those under the expectant plan of treatment. The cases of rheumatism did well under it with one exception. After considerable doses the pain subsides in three days and disappears in five. It must be an exceptionally severe case if the pain has not disappeared by the fifth day. In four of the ten cases relapse occurred, but three of these required only one dose of forty-five grains. In all of these cases the remedy had been discontinued on the cessation of the pain, and the cure was effected with salicylate of sodium, but the patients experienced ringing in the ears, headache, and vertigo which they had escaped when taking antifebrin.

The author concludes that although antifebrin cannot fill the place occupied by salicylic acid in the treatment of acute rheumatism, it is quite possible in many cases to effect a cure with the former without the unpleasant effects produced by the latter remedy.

The effects of antifebrin have also been studied by LÉPINE (*Ibid.*), whose conclusions are as follows: In typhus the effects of antifebrin are similar to those of antipyrin. At the point of minimum temperature, antifebrin does not induce a collapse-like condition of depression, but rather increases the power of the pulse whilst it lessens the number of beats. In severe cases it may cause cyanosis, and lessen the urinary secretion.

Antifebrin is a nervine. The lancinating pains of the tabetic are always calmed as if by magic with one or two doses of eight grains each. It has also been used in neuralgia with success, and in a case of multiple sclerosis it lessened the trembling and improved the patient's strength.

Inhalation of Carbolic Acid in Whooping-cough.

PICK, in a late paper (*Deut. med. Wochenschrift*, No. 21, 1886), maintains that the inhalation of carbolic acid gives the best results in whooping-cough. The failures of this remedy which have been reported were due, for the most part, according to Fick, to too great dilution. By means of a special mask which he has made and figured in a paper published three years ago, he administers fifteen to twenty drops of the pure acid, on a roll of cotton, introduced into the mask. The inhalation is carried on for several hours every day, the cotton wad being renewed three times a day. No ill results have occurred, and the duration and violence of the disease notably lessened.

The Effect of Fluids on Febrile Heat.

PROF. GLAX has recently called attention (abstract in *Bull. Gén. de Thérap.*, Jan. 30, 1887) to the fact that drinking fluids increase the temperature of fevers. During fevers there is retention of liquids, and it is only when the temperature returns to the normal that they are evacuated in quantity. The rise of body-heat is in direct ratio to the accumulation of fluid in the organism,

and Prof. Glax has ascertained that the temperature is notably reduced by withholding liquids. He explains this by supposing that the dilatation of the vessels, which is an incident of the febrile process, permits the accumulation of water in the blood, and thus there is a more prolonged contact of the red globules with the tissues, increasing oxidation or combustion.

Phosphate of Lime in the Treatment of the Sweating of Consumption.

Dr. Rebory, in his Thèse de Paris (*Revue de Thérapeutique*, February 1, 1887), maintains that phosphate of lime is the most efficient remedy we have to arrest the sweating of consumption. In many cases the beneficial effects are experienced on the day of its administration. It diminishes or arrests the sweats completely, often for a long time. The special advantages of the phosphate of lime are, that it is not a poison, is easy to administer, is well borne by the stomach, promotes nutrition, lessens the diarrhœa, and can be taken for a long time with decided benefit to the general health.

Vaseline for Hypodermatic Injections.

In a communication, which appears in the *Bul. Gén. de Thérap.* for Jan. 15, 1887, M. le Dr. Meunier, of Lyons, advocates the employment of vaseline as an antiseptic subcutaneous injection. After a course of experiments on animals, he ascertained that the method was perfectly adapted to the same mode of medication in man. Vaseline, he finds, diffuses readily through all the tissues, and the solutions made with it can be employed topically to the skin and mucous membrane, or be administered by the stomach. He insists that chemically pure vaseline be used in making the preparations. The following formulæ are proposed for hypodermatic use:

℞.—Eucalyptol (pure) . . . . . ʒss.
Vaseline (chem. pure) . . . . . ʒij.—M.

Fifteen grains to two drachms may be administered in twenty-four hours.

℞.—Eucalyptol (pure) . . . . . ♏20
Iodoform . . . . . gr. j.
Vaseline (chem. pure) . . . . . ℈iv

The dose of this is the same as the preceding.

℞.—Turpentine (pure, prepared according to the method of Berthellot) . . . . . ℈j.
Vaseline (pure) . . . . . ℈iv.

Of this, fifteen grains to two drachms may be given each day.

When tinctures of essential oils are to be administered, Dr. Meunier advises that, their purity being ascertained, they should be dissolved in pure vaseline, allowed to stand, and then filtered through two leaves of Swedish filtering paper. The author of these suggestions must refer to liquid vaseline.

Antipyrin in Hemicrania.

Dr. Ungar, in a paper which we find in the *Centralblatt für die gesammte Therapie*, January, 1887, proposes the use of antipyrin in hemicrania, this application of the remedy having been suggested by the similarity of its

actions to those of salicylic acid. In some cases, administered when the first prodromes of the attack manifested themselves, it had sufficed to prevent them. In other cases, given during the maximum suffering, it distinctly alleviated the distress. Some were greatly benefited by it who had exhausted all the known remedies previously. In some instances, however, the relief afforded by it in one attack was not experienced in another; and in other cases it was without any value as a remedy. The dose varies from fifteen to twenty grains according to individual susceptibility.

Nitroglycerine in Heart Diseases.

Dr. L. v. Holst (*St. Petersb. med. Wochenschrift*, 30, 31, 1886; quoted by *Centralblatt f. Gesam. Therapie*, January 7, 1887) publishes some clinical experiences in the use of nitroglycerine in neuroses of the heart, valvular lesions, pulmonary œdema, etc. He finds that this remedy is a nervine, and one that powerfully affects the nervous apparatus of the heart. In cases of cardiac feebleness with little or no degenerative changes, the action of nitroglycerine was uniformly favorable. Cases of angina were greatly benefited, and sometimes cured. In all instances of cardiac failure, the organ being free from important degenerative changes, it should be administered instead of nerve and vascular stimulants, as camphor, musk, etc., which have hitherto been used. He mentions typhus and pneumonia, as maladies in which this practice is advisable. He does not regard nitroglycerine as a diuretic, although in many cases he has observed an astonishing flow of urine as a result of its action. This result, he thinks, is due to the vascular changes caused by it, for when the kidneys are alone diseased, it does not increase the flow of urine.

Dr. von Holst advises the use of the alcoholic solution—one per cent. The dose is not a fixed one, and must be varied according to the individual susceptibility, which is very different. Some patients are affected by three drops, others by six drops of the one per cent. solution, and hence it is necessary to begin with one drop and increase the dose until its effects are felt.

MEDICINE.

UNDER THE CHARGE OF

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Investigations Concerning Icterus.

F. Müller contributes to the *Zeitsch. f. klin. Med.*, B. xii. H. 1 and 2, 45–114, the results of an elaborate research upon the disturbances occurring in the intestinal canal in icterus. His method consisted in administering nourishment whose quantity and composition had been accurately determined;

and in ascertaining by analysis of the feces, how much of each class of nutritive substances had been absorbed.

After detailing his experiments, with remarks upon each, case he gives the following *résumé* of his conclusions:

1. In case of obstruction to the entrance of bile into the intestine, the absorption of the starches does not suffer at all; that of the albuminoids is at most only slightly affected; that of the fats is very much interfered with. In total failure of bile, 55.2–78.5 per cent. of the fat contained in the nourishment ingested is passed with the feces; while in health only 6.9–10.5 per cent. thus appears.

2. In the absence of the pancreatic secretion from the intestine, the digestion and absorption of the amylacea are not at all disturbed; though it would seem that those of flesh are a little less complete. An increased amount of fat in the stools could not be detected; and it is doubtful whether steatorrhœa is a symptom of diseases of the pancreas.

3. In diseases of the absorbing apparatus of the intestine (tuberculosis; amyloid disease; disease of the mesenteric glands; enteritis) the absorption of fat suffers much more greatly than that of the other constituents of the nourishment; and the feces exhibit the macroscopic, microscopic, and chemical characteristics of the fatty stool.

4. In healthy persons, as well as in cases of icterus, when the pancreatic secretion has access to the intestine, the fat in the feces appears to be almost entirely decomposed (on the average 84.3 per cent.). In 3 cases, in which there was a closure of the pancreatic duct, or a degeneration of the gland, a much less degree of decomposition was recognizable (39.8 per cent.). It seems, therefore, that absence of the secretion of the pancreas from the intestine produces a *qualitative* and not a *quantitative* change in the fecal fat. Fresh pancreatic juice will disintegrate fat far more completely and rapidly than bacteria will do it.

5. The more complete the absorption of fat in the intestines, the higher is the melting point of the fat in the feces. Fats which melt easily are absorbed better than those of a higher melting point.

6. Needle-shaped fat-crystals in the feces are an indication that the absorption of fat has been interfered with. They occur in icterus, and in other diseases in which there has been imperfect digestion of fat. They consist of free fatty acids, and of lime and magnesia soaps.

7. In cases of simple icterus there is no pathological alteration in the albuminous constituents; and the condition of the neutral sulphur and of the compounds of the sulphur-acids does not differ from that in health.

Cyclic Albuminuria.

G. Klemperer (*Zeitsch. f. klin. Med.*, B. xi., H. 1 and 2, 168) reviews the cases which are, or should have been, reported under this title; adds one of his own, and appends the following conclusions:

Cyclic albuminuria presents characteristic pathological features. It attacks chiefly young persons, and especially males. The patients usually present some nervous (neurasthenic) symptoms; often are troubled by indigestion, and may be somewhat anæmic; but exhibit no signs of Bright's disease.

Indeed, all symptoms except the albuminuria may be absent. Albumen is never to be found in the nocturnal urine, and the degree of albuminuria varies at different hours during the day. These variations appear to obey a certain law, and to follow a definite order in each case; but the hour at which the highest degree of albuminuria is reached, and the cycle as a whole, is not the same in different individuals. The time at which food is taken, and the composition of the nourishment appear to have no effect on the albuminuria; but muscular exercise often, though not in every case, influences it decidedly, and great mental strain appears to have some effect. It is almost certainly diminished by improving the state of the general health. It is prone to disappear temporarily if the patient be confined to bed. Its course is chronic; it is the source of no danger to life. It does not become transformed into severe disease of the kidney, and it may finally greatly diminish or disappear entirely.

The Treatment of Chlorosis with Sulphur.

According to Schulz and Strübing (*Deutsche med. Wochensch.*, No. 2, 1887, 24) three forms of chlorosis may be distinguished therapeutically: 1st, that which disappears on the simple treatment of an imperfect digestion; 2d, that for which the use of iron is necessary; 3d, that which is unaffected or made worse by treatment with iron. For this form the authors have employed sulphur, on the ground that it is one of the constituents of the tissue. They report a series of such cases treated in this way, and give the following generalizations of the results obtained:

1. In the cases of pure chlorosis in which iron was without effect, the general condition was greatly improved by the use of sulphur.

2. After sulphur had been given for a considerable time, the treatment with iron could be commenced and carried out with good results.

3. In those cases of chlorosis which were complicated by catarrhal or inflammatory conditions of the digestive tract, sulphur was not well borne.

On Lavage of the Stomach in Peritonitis.

Encouraged by Senator's employment of this method in peritonitis with excessive meteorism, Lewin has used it in two instances with excellent results (*Berliner klin. Wochensch.*, 1886, No. 44, p. 763). Both were cases of acute peritonitis following operation for strangulated hernia. Lavage was performed three times daily, and followed by the administration of opium. Immediate relief was obtained, pain and eructation were lessened, and sleep procured. Opium had been previously employed without effect. The washing removed the continually accumulating grass-green masses, and diminished the meteorism.

On the Condition of the Urinary Ferments in Bright's Disease.

It has been already proved that normal human urine contains two ferments which act respectively as do pepsin and trypsin. Mya and Belfanti (*Centralbl. f. klin. Med.*, 1886, No. 42, 729) have studied the changes which these undergo in different diseases. They determined the amount of each ferment

present by allowing them to act conjointly for a certain length of time upon accurately weighed portions of fibrin. The fibrin was then removed from the urine; and with it, of course, the ferments with which it had combined. The digestion was then allowed to proceed in artificially prepared fluids suited for the purpose, the loss of weight of the fibrin estimated, and the quantity of each ferment then easily determined. A large number of cases of various diseases were examined, but no constant results obtained, except in Bright's disease. Of this affection twenty-eight cases were studied, and the ferment resembling trypsin was found to be *invariably absent*, while the uropepsin was usually present. In albuminuria not dependent upon disease of the kidney, urotrypsin always occurred. The writers are of the opinion that this failure of the urotrypsin cannot be due simply to the presence of albumen in the urine, but is directly dependent upon the condition of the kidney itself.

On Paroxysmal Hæmoglobinuria.

Bruzelius (*Nordiskt. Medicinskt Arkiv.*, 1886, xviii. 22, 1–37) reports three cases of this affection, which seems to be especially rare in Norway and Sweden, though uncommon everywhere. In each of the three patients attacks of hæmoglobinuria were caused solely by exposure to cold. In one patient chilliness, elevation of temperature, perspiration, urticaria, sacral pains, and icterus were seen as accompanying symptoms. Other observers have reported fatigue as a cause, and some claim that syphilis is the true agent in its production. Bruzelius is of the opinion that the disease is a disorder of the blood, in which the destruction of the corpuscles takes place in the organs of circulation, and not in the kidney only, as Rosenbach believes.

On the Examination of Diabetic Urine.

One of the difficulties in the determination of the presence of sugar in diabetic urine is the occurrence of bodies interfering with or responding to the tests for it. In some cases oxybutyric acid destroys the exactness of the quantitative estimation with the polariscope. Being a substance which deviates the polarized ray to the left, it thus neutralizes, to a certain extent, the property of right-sided deviation which grape sugar possesses. Leo (*Deutsche med. Wochensch.*, No. 49, 1886, 869) has recently discovered a substance belonging to the group called "reducing agents," on account of their power to reduce the metallic oxides in alkaline solution. This body is a carbohydrate, has the same empirical formula as grape sugar, dissolves CuO in the presence of alkali, and reduces it on boiling. It does not, however, undergo fermentation, and deviates the light to the left. Its reducing power is about one-half as great as that of grape sugar, and it is necessary to boil for some seconds before the Cu_2O is precipitated. Leo has found this body in three cases of diabetes, but absent in a great many. Its occurrence appears to have no special import, except that it often makes the amount of sugar as determined by the copper test appear much greater than it actually is. The author insists that some other test must be employed to obtain accuracy, and especially recommends that by fermentation.

Antifebrin in Typhoid Fever.

Grueneberg (*Berlin. klin. Wochensch.*, 1886, No. 49, 849) reports his results from the use of antifebrin in numerous cases of typhoid fever. The antipyretic effect was all that was sought. By a dose of 4–8 grains the temperature was usually reduced 3–4½° F. It rose again within the next four hours, the rise being often preceded by a chill. No injurious action upon the intestinal tract was seen. Profuse sweating was very common, but the author has never observed cyanosis or reddening of the skin, as after antipyrin. There was also no sensation of burning, or nausea, or vomiting, as often occurs with the older antipyretic.

Calomel as a Diuretic in Diseases of the Heart.

The use of this agent as a diuretic has been known and forgotten. Recently it has been revived by Jendrássik and by Stiller; and Mendelsohn (*Deutsche med. Wochenschrift*, 1886, No. 45, 796) now adds his experience confirming its value in cardiac dropsy. He found it very useful combined with digitalis, and even sometimes effective where the latter drug alone had totally failed. It was best given in doses of three grains three times a day. Diuresis was induced after forty-eight hours, and the administration of the drug was then stopped. Salivation was never produced. He can give no explanation of the manner of its action.

Clinical Observations on Ulcer and on Cancer of the Stomach, and on Gastric Hemorrhage; with Experimental Investigations on the Condition of Blood in the Human Stomach.

In consideration of this subject, Korczynski and Jaworski (*Deutsch. med. Wochensch.*, Nos. 47, 48, 49, 1886) detail the examination of 52 cases.

I. *The clinical examination of patients suffering from gastric ulcer.* The œsophageal sound was employed in all cases except where the diagnosis could not be questioned; and the function of the stomach tested in three ways:

1. Aspiration of the stomach after strict fasting. If there be nothing to aspirate, 100 c. cm. of distilled water are ingested immediately before the operation. The contents of the viscus are then examined chemically and microscopically.

2. The stomach, empty of food, is examined by the modified ice-water method with regard to its secretion of HCl.

3. The empty stomach is examined by the albumen method regarding its digestive capability and mechanism.

In case remnants of food from the previous day are found, the organ is thoroughly washed out. In this way the authors think the result of an examination is much more accurate than when the ordinary contents of the stomach are studied, no previous fasting having been enjoined. The presence of HCl was determined by the methyl-violet test, although more reliance was placed on the digestion of a known weight of albumen. The authors confirm the fact that the gastric juice, to be capable of digesting, *must* contain HCl as well as pepsin. In some cases it was necessary to examine the contents of the stomach obtained without previous fasting or lavage.

24 of the 52 cases suffered from gastric ulcer, and in 6 of these the evidences of hemorrhage were discovered solely by the internal examination of the stomach. These 6 are reported at length. In the other 18 the diagnosis rested upon (*a*) the statement of the patient that there had been black vomiting and stools followed by a feeling of weakness; (*b*) the long duration of the disease without outspoken cachexia; (*c*) local results of the pathological process (stenosis of the pylorus; dilatation). In all the cases the secretion was much increased, and a considerable amount of fluid could be withdrawn from the stomach after fasting. This always contained a comparatively large amount of free HCl—larger than in any other disease—even when no remnants were present. The acidity was especially high at the time of a hemorrhage. The mechanical emptying of the viscus was much delayed, and in many cases it was never found entirely empty of food. The excessive thirst and hunger, so often complained of, are due to the great acidity rather than to the ulcer itself. Peptone could be always detected by the $CuSO_4$ test.

Their treatment of *ulcer ventriculi* differed somewhat from that ordinarily advised. In case of a hemorrhage absolute rest in bed for the first two days was enjoined, and a small ice-bag placed over the stomach. Swallowing of ice was only permitted to quench thirst, as it increases the secretion of acid; powders of sod. borat. and ext. opii, with small quantities of Carlsbad water, were given. This diminished the acidity and increased the mechanical action of the stomach. No food or drink was allowed. During the second two days no more ice was given if the bleeding had stopped. The diet was now cautiously increased, but at once reduced if pain was produced; and great care was exercised for three weeks at least. A small amount of stimulant was permitted if there was much weakness. Where there had been no hemorrhage the method was the same, except the strict regimen of the first two days. If there was much dilatation, lavage was added to the means described.

II. *Clinical observation in carcinoma of the stomach.* 28 cases were subjected to an internal examination of the stomach; and in 5 of these, which they report in full, recently effused blood was discovered in this way. In the other 23 the correct diagnosis was evident, although no blood was found. Anæmia was present in nearly all the cases, but without the waxy yellow color so often seen in ulcer. In every instance digestion was retarded, and in many cases the stomach, even after fasting, was overfilled with fragments of food. The secretion examined in the manner described was almost always found to be of neutral or alkaline reaction, mucous in character, and diminished in amount. HCl could be detected in the secretion of only 2 patients; both under 30 years of age. Yet in some cases the copper reaction for peptone could be obtained. The authors think some other substance than peptone produced this result.

The symptomatic treatment of cancer employed by them consisted in the administration of HCl and morphia several times a day on an empty stomach, with acid foods and wine. If fermentation of the ingested food occurred, salicylate of soda and borate of soda were given. Lavage was performed from time to time in cases of dilatation.

Korczynski and Jaworski do not accept the view of Riegel, that the secretions of the cancer destroy the normal juices of the stomach, but rather believe that the absence of HCl, as seen in the mucous catarrh of old persons,

drunkards, and others, predisposes to the development of the neoplasm. On the other hand, excessive acidity often produces an ulcer by its action on the mucous membrane.

Their remaining conclusions regarding ulcer and cancer are largely expressed in a diagnostic table of symptoms.

Ulcus.	*Carcinoma.*
1. A high degree of an acid gastric catarrh.	1. Very marked mucous catarrh, except in young persons.
2. Unusually large amount of HCl, and very energetic digestive power of the gastric juice.	2. Complete absence of HCl, and diminution of the formation of pepsin.
3. Blackish-brown coffee-ground vomit, with a smell of peptonized blood, and with destruction of the red blood cells.	3. Light, chocolate-colored vomit, smelling of fatty acids; and with remnants of red blood cells.
4. Appetite preserved, or abnormally increased.	4. Appetite much diminished.
5. Excessive thirst.	5. Usually no thirst; often a desire for acids.
6. Burning, cutting, often pressing pain of great intensity.	6. Dull, continuous pain, with a sense of pressure.
7. Usually no palpable tumor.	7. Usually a painful tumor to be felt.
8. Vomiting in most cases.	8. Vomiting in one-half the cases.

III. *Results of experiments respecting the condition of the blood in the human stomach.* Korczynski and Jaworski have further made some careful studies upon the digestion of blood, both within the stomach and by the secretions freshly removed from it. They found that in digestion outside of the viscus the blood corpuscles preserved their shape for a long time, to a greater or less extent. When ingested, however, they lost their form, for some reason, with extraordinary rapidity. From extended investigation they draw conclusions which corroborate their views obtained from clinical study:

1. That dark-colored gastric contents are probably, but not always caused by the presence of blood.

2. Dark brown material, like coffee-grounds, and smelling of peptonized blood, indicates ulcer. A dirty-gray, or light chocolate-colored substance, with an odor of the fatty acids or vinegar, indicates carcinoma.

3. A red, or red-brown filtrate, perhaps containing red blood cells, points toward a recent hemorrhage.

4. Gastric contents containing blood, which give a filtrate strongly acid with HCl, and of energetic digestive power, are characteristic of ulcer, while a filtrate free from HCl, and not capable of digesting, is characteristic of carcinoma.

5. An effort to produce hæmin crystals must be made, or the iron test for blood employed in all cases where the microscopic examination does not render the diagnosis certain.

6. Hæmin crystals will form spontaneously after several days in matter from the stomach containing blood and HCl.

It must not be forgotten that small effusions of blood may be produced by other means, as from slight abrasions of the mucous membrane by the sound, or from capillary hemorrhages.

The Poisonousness of Cholera Bacilli.

Cantani, in considering this subject (*Deutsch. med. Wochensch.*, No. 45, 1886, 789), says that there are three possible means by which the cholera poison may produce death:

1. *Ptomaine.* A ptomaine may be formed by the vegetative activity of the bacilli in the intestinal canal; and this may be taken up by the blood.

2. *Secretion.* A special poison may be secreted by the bacilli, and in like manner be absorbed by the blood.

3. *Digestion.* The bacilli themselves may act directly as the poisonous agent. In this case it is by their death and digestion in the alimentary canal, and by their being taken up by the blood, that they act injuriously on the system.

The author concludes from his experiments upon animals, that it is probably by the last of these methods that the bacilli kill.

The therapeutic indications are two:

1. To limit the increase of the bacilli in the intestinal canal.

2. To aid in the elimination of the poison from the blood.

To fulfil the first, Cantani recommends very large enemata (2–3 or more litres) of a solution of 3–10 grammes of tannic acid in 1½–2 litres of water, sterilized by boiling, and used hot. He employs a simple irrigating apparatus of his own device, elevated 2–4 metres above the patient. By this means he has been able slowly to pass the injection even as far as the stomach. Antiperistalsis, excited by the presence of the injection, has greater effect than pressure in accomplishing the upward passage of the liquid. The therapeutic results obtained have been most gratifying, especially when the treatment was instituted early. That the tannic acid had something more than a simply astringent effect, the author proved by observing its action upon cultures of the bacilli, whose growth it seemed nearly or entirely to check.

The second indication is met very satisfactorily by the hypodermatic injection of ½–1 litre of a hot saline solution, containing 4 grammes of chloride of sodium and 3 grammes of carbonate of sodium to the litre of warm, sterilized water. This prevents thickening of the blood; and, at the same time, removes the cholera poison from it and from the tissues.

On Primary Degenerative Neuritis.

Kast (*Deutsches Archiv f. k. Med.*, B. 40, H. 1, 41–62) reports four cases of this disease which add to our clinical and anatomical knowledge of its symptoms and peculiarities.

The first occurred in a girl, aged thirteen, just recovering from angina follicularis, and seemed to be an instance of systemic infection from it. The first symptom was a paresis of accommodation. The case was further characterized by a progressive ataxia of the upper, and later of the lower, extremities; disturbances of sensibility, with diminution and retardation of the perception of painful sensations; tearing pains at first, but later no subjective complaints; never any tenderness of the nerves on pressure; atrophic paralysis of the in-

terossei and of the tongue; absence of the faradic, and great diminution of the galvanic electrical contractility; abolition of the tendon reflexes, and gradual development of bulbar symptoms. Nine months after the beginning of the disease the patient died of lobar pneumonia. The post-mortem examination revealed nothing amiss with the central nervous system, but a multiple degeneration of the cranial and spinal nerves.

The three other cases lack the confirmation of an autopsy, but exhibit the clinical symptoms of the disease in question.

The second case occurred in a habitual drinker, and began with optic neuritis. Then followed a feeling of exhaustion, weakness, and formication in the legs; atrophic paralysis of both lower and upper extremities, accompanied by an attack of delirium tremens; multiple swellings of the joints; violent tearing pains, and croupous pneumonia. There was also slight tenderness of the nerves on pressure, with irregularly distributed, complete or partial reaction of degeneration.

The third case was one of puerperal infection with septic endocarditis. Soon there appeared atrophic paralysis in the parts supplied by the ulnar and median nerves, with partial or complete reaction of degeneration, and violent pains in both arms. The nerve trunks were tender on pressure; there was anæsthesia of both hands, and temporary parästhesia and weakness of the feet. Complete recovery followed.

The fourth case was one of severe neuritis following a subcutaneous injection of ether. Paralysis of the radial nerve, and complete reaction of degeneration followed. After several months recovery took place. A discussion of the symptoms accompanies the report of each case.

Concerning a New Micrococcus—The Pathogenic Agent in Infectious Tumors.

Under this title Manfredi (*Fortsch. d. Med.*, B. 4, No. 22, 713–733) publishes an elaborate paper accompanied by colored plates. The micrococcus in question was found, accompanying that of Friedländer, in the sputum of patients dying of pneumonia after measles. He names it "the micrococcus of progressive lymphoma in animals." He then describes its form and its method of growth upon culture media. It was found to be exceedingly infectious to dogs, rabbits, guinea-pigs, and mice, and this infectious nature seemed to be extraordinarily persistent. The inoculated animals died after seven to twelve days, and exhibited enormous swelling of the spleen and liver, with a deposition in them, and in the lungs, lymphatic glands, and elsewhere, of gray or grayish-yellow nodules. These were composed of granulation-tissue, and belonged to the type of granuloma or infectious granulating tumors. With this were combined the characteristic signs of more or less pneumonia, even when the inoculation had been made in the subcutaneous connective tissue. The organism appeared to diffuse itself by means of the lymphatic system.

On Changes in the Portal Circulation Caused by Obstruction to the Discharge of Bile.

In the *Deutsches Archives f. k. Med.*, B. 40, H. 1, 83–93, Maragliano reports five cases illustrating the simultaneous and proportionate development

of icterus and enlargement of the spleen, and in which the latter disappeared as the former diminished. There being no other assignable cause for the splenic enlargement, the author believes it must be due to passive congestion; and, after advancing several arguments in support of this opinion, he concludes:

1. That the pressure of the overfilled biliary vessels upon the portal capillaries within the liver hinders, in a purely mechanical way, the discharge of blood from the portal system.

2. That symptoms of portal congestion, such as enlargement of the spleen and ascites, can be occasioned by this obstruction to the emptying of the portal veins.

3. That in catarrhal icterus, and in the icterus of engorgement in general, and especially in the hypertrophic form of interstitial hepatitis, the splenic swelling can be produced in the manner described.

The Clinical Value of Uric Acid Sediment in the Urine.

From 3287 examinations of the urine of 272 cases, made with reference to the occurrence in it of uric acid, and its connection with albuminuria, Mygge (*Nordiskt Medicinskt Arkiv*, 1886, xviii. 33, 1–17) found that no free acid occurred in 2786 examinations of 127 cases. Only 59 patients (262 examinations) exhibited uric acid abundantly at times, and in but 16 of these did its occurrence persist during a week or month.

The sediment was most often found in rheumatic affections and in pneumonia. In quite a number of cases lithæmia was seen coincident with albuminuria. Frequently, too, uric acid appeared as an acute albuminuria ceased; and, in many other lithæmic cases, microscopical examination revealed the presence of tube-casts and of renal epithelium. The author is convinced that there is a very frequent, if not a constant, relation existing between renal affections and the persistent deposition of uric acid in the urine. He is, however, unable to explain the nature of this relation. The albumen may be produced, in some cases, by the prolonged action of the highly acid urine upon the tubules; or in others the precipitation of uric acid may be induced by the morphological elements already existing in the urine coming from kidneys already diseased. Uric acid sediment also seems to bear some relation to the desquamation of vesical epithelium, and to certain forms of incontinence of urine.

The Futility of the Sublimate Treatment of Typhoid Fever.

Gläser (*Deutsches Archiv f. klin. Med.*, Bd. 40, H. 1, 31–41) contributes his experience, which is diametrically opposed to that of Greiffenberger. He gives the notes of twenty-three cases treated with sublimate, and the temperature-curve and pulse-curve of each. The quantity of the drug employed was about 0.3 grm. in divided doses during the twenty-four hours. He thinks it can have no possible action in destroying the bacillus, since it reaches in the blood a dilution of at least 1 in 104,000 in a man of 130 pounds weight. It is also rapidly eliminated from the system, and can therefore have no cumulative action. Gläser's conclusions from his case records are:

That by the use of sublimate the mortality of typhoid is not diminished; the temperature does not return any sooner to normal; the tongue is not made moist: the eruption of roseola not prevented or removed; the general condition of the patient not improved; and the duration of the disease or the liability to relapse not lessened. Thus, of all the claims of Greiffenberger, only that of the harmlessness of this plan of treatment can be admitted.

On the Influence of Venous Stasis on the Urine.

Paneth has found that venous engorgement, even of moderate degree, diminishes the amount of urine, and that the administration of some diuretic (saltpetre) increases the secretion, in spite of the congestion. Senator and Munk (*Centralbl. f. d. med. Wissensch.*, No. 3, 1887, 33) have studied the subject more carefully, and, while confirming both points, add considerably to the extent of Paneth's observations. They find, namely, that in venous stasis the amount of urine is always lessened, and the per cent. of urea very much diminished. On the other hand, the per cent. of chloride of sodium is not notably decreased, while that of albumen is constantly increased. This condition of the secretion of albumen is undoubtedly an indication that under the influence of the passive congestion the function of the kidney is interfered with, while the behavior of the urea proves that it is the *specific secretion* which is especially injured. The fact that the sodium chloride is not affected shows that this salt is not eliminated by a specific glandular secretion. The production, too, of the water of the urine cannot be called purely the act of secretion by a gland.

Cephalalgia Pharyngo-tympanica.

Under this title, Legal (*Deutsch. Archiv f. klin. Med.*, B. 14, H. 2, 201–217) reports ten cases of a temporo-occipital headache, etiologically connected with affections of the pharynx or ear. It is characterized by more or less violent paroxysmal pain occurring in the region supplied by the terminal branches of the auriculo-temporal and great occipital nerves; is accompanied by disturbances of sensation in this region, and by tenderness of the nerve trunks on pressure; and is relieved by proper treatment of the coexisting catarrh of the pharynx or middle ear. The pain is described as pulling, tearing, shooting, etc., and between the paroxysms there may be a continuous, dull, painful sensation on the affected side of the head. Bodily exertion, coughing, straining at stool, often increase this feeling. In some cases the patient was unable to bear with comfort the pressure of the lightest hat, and the jarring of his footsteps was painful to him. If attacks came at night, the sleep was disturbed. The left temporal region is the favorite seat of the pain. Hyperalgesia is commonly present. The presence of sensitive points is an additional proof that the affection is of a neuralgic nature. The occipital neuralgia appears to be especially connected with the pharynx, while the temporal pain is more nearly related to some disease of the middle ear. This is usually some chronic, catarrhal trouble, producing symptoms so slight that they are generally overlooked. Yet Legal found that local treatment appropriate for the catarrh of the pharynx and middle ear often cures the headache

in a very short time, and this without any anti-neuralgic or tonic treatment. The author thinks it possible that the violent, almost neuralgic headache sometimes accompanying various acute diseases is due to the affection of the mucous membrane which often coexists. He cannot explain in what way the neuralgia is connected with the pharyngo-tympanic catarrh.

ON THE SIGNIFICANCE AND DETERMINATION OF GLOBULIN IN THE URINE.

R. MAGUIRE (*Lancet*, June 5, and September 18, 1886) discusses the varieties of albumins occurring in the urine in cases of albuminuria, and suggests that an investigation to determine the presence of different kinds, as well as their relative quantities, may lead, perhaps, to practical information, important for diagnostic and prognostic purposes.

The presence of globulin and its proportion to the quantity of serum-albumin has especially engaged his attention. Ordinarily, it seems, both are present in the urine of nephritis, the serum-albumin preponderating. In some cases, however, the globulin is present in larger quantities than ordinary, while, in some cases of what appeared to be functional albuminuria, globulin alone was found. Thus, in four observations on what seemed a case of cyclic albuminuria, as well as in a case of puerperal albuminuria in which the albumin was rapidly disappearing spontaneously, globulin alone was found. Thus a possible common origin for these two conditions is suggested.

For separating the globulin from the serum-albumin he adopts the method of saturating the previously neutralized urine with magnesian sulphate. This neutralization is important, for, if the urine be acid, the serum-albumin will be precipitated as well. The globulin is precipitated in an uncoagulated form, it being subsequently freely soluble in water.

In experiments on artificial ox-blood serum, made by dissolving dried blood-albumin in water, HOFMEISTER and KAUDER (*Arch. f. exp. Path.*, vol. xx. p. 411) found that when ammonium sulphate was added till it formed from 24.1 per cent. to 33.6 per cent. globulin alone was precipitated. When the concentration exceeded 33.6 per cent. the precipitation of serum-albumin began, and when it reached 47.2 per cent. the precipitation of the latter became complete. (A cold saturated solution of ammonium sulphate contains 52.4 per cent. of the salt.)

This method of fractional precipitation has been applied by HOFMEISTER and POHL (*Arch. f. exp. Path.*, vol. xx. p. 426) to the separation of the albumins of the urine. It was found that if to a given bulk of urine previously made alkaline by ammonium hydrate, an equal quantity of a saturated solution of ammonium sulphate were added, all the globulin would be precipitated. This, after being allowed to settle for one hour, was filtered, washed with a half-saturated solution of the ammonium sulphate, then with boiling water, and subsequently with alcohol and ether, dried at 110° C., and afterward weighed and ignited.

For a rapid qualitative test they recommend adding the ammonium hydrate to the urine, filtering off the resulting turbidity, and then adding an equal volume of a saturated ammonium sulphate solution.

SURGERY.

UNDER THE CHARGE OF

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Recent Surgical Literature.

The last volume of the *Dictionnaire Encyclopédique des Sciences Médicales* runs from "Peric" to "Perit," and contains the following papers of surgical interest: The article "Perinée," by M. Kirmisson, is complete and well written, and especially valuable for the full account it gives of the various operations for the relief of rupture of the perineum. The article "Perioste" is one of the most important that has appeared in this great work. The anatomy of the periosteum is dealt with by M. Retterer, and is exhaustive and original. M. Heydenreich, under the title of "the pathology of the periosteum," discusses the part played by this membrane in bone affections, scrofulous gumma, and the whole subject of the regeneration of bone. The elaborate treatise on periostitis is from the able pen of M. Kirmisson.

The next article is on the peritoneum. The anatomy, histology, physiology, and development of the peritoneum are dealt with by M. Baraban. The monograph will become classical. It is complete and up to date, and abounds with original matter. The subject of peritonitis is only commenced. The treatise will probably occupy the greater part of the next volume.

Éléments de Pathologie Chirurgicale Générale, by Prof. Baudry (Paris, 1886, vol. i.). This is a small work, the precise object of which is not very evident. The present volume deals with acute and chronic inflammation, hemorrhage, thrombosis, gangrene, ulceration, and injuries in general. The matter is well arranged. Considerable space is devoted to theoretical subjects, but the book as a whole shows no evidence of original work.

Handbuch der Chirurgischen Technik, by Dr. Mosetig-Moorhof (Leipzig, 1886). This is the first part of what promises to be a very complete treatise upon operative surgery. The first section deals with narcosis and local anæsthesia. The second embraces the whole subject of the general treatment of wounds. This chapter, written in a liberal spirit, provides an excellent review of the present position of this branch of practice. The third section is concerned with what are termed elementary operations, such as arrest of bleeding, use of écraseur, bloodless methods of operating, etc. The volume concludes with general operations upon the various tissues. The work is exhaustive and elaborate, and well illustrated, and if the remaining volumes are written with the same care and ability as the present one the book will probably prove to be the best treatise on operative surgery in recent times.

Die Heilstätten für scrophulöse Kinder, by Dr. Scheimpflug. This work deals with the various establishments for the treatment of scrofulous children in Europe. At least two works upon the same subject have been published

within the last eighteen months in France. The present volume has the advantage of brevity. It is at the same time very complete and well up to date. It embraces England, France, Germany, Austria, Italy, Belgium, Holland, Russia, and Denmark. It is illustrated by a few good plates.

Traité de Chirurgie Clinique, by PROF. TILLAUX (Paris, 1886, vol. i.). This is the first volume of a work by the celebrated author of *Anatomie Topographique*. It is very disappointing. The present volume deals with the head only. Within 386 small pages the author discusses injuries and diseases of the head, eye, ear, nose, mouth, and tongue. The various subjects are, of necessity, treated in the most scanty manner. No illustrative cases are given, and in the English sense the work would not merit the title of "Clinical Surgery." It is a systematic treatise on surgery in outline. The illustrations are few and conspicuously poor. The work will not add to its author's reputation.

L'Hermaphrodisme, by DR. DEBIERRE (Paris, 1886). This small work aims at giving a complete account of hermaphroditism. The subject has always attracted more interest in France than in England. The best known cases are described, and are represented by very good woodcuts. It cannot be said that the volume adds to our present knowledge, but the completeness of its scope is no small point in its favor.

Traité des Manœuvres d'Ambulance, by DR. A. ROBERT (Paris, 1886). This is a large work of 630 pages that should exhaust the subject of ambulance. It is illustrated by a vast number of original and most excellent woodcuts.

It gives a complete account of the medical department of the army, of the equipment of the various field hospitals, and of the duties of the different medical officers. Another chapter concerns the general arrangements in the field. A considerable part of the book is devoted to the first treatment of the wounded and the subject of transport. The author appears to have made himself acquainted with every form of ambulance, wagon, and stretcher, and to have exhausted all possible forms of transport, good, bad, and indifferent. A long account is also furnished of the operating chest and its contents. The book is admirably arranged, and gotten up with unusual care.

Traitement chirurgical de la Péritonite, by DR. TRUC (Paris, 1886). The leading point of this little monograph is rendered evident by the motto on its title page, "Ubi pus ibi evacua." The author gives an account of the various forms of peritonitis, and then of the treatment by laparotomy, evacuation of the effusion, washing out of the cavity, and drainage. He gives a number of illustrative cases. The work does not aim at originality. The author's conclusions have long been accepted by the majority of surgeons. As a literary production the book deserves high praise. Perhaps its most valuable feature is an exhaustive bibliography of "the surgical treatment of peritonitis."

Traité des Kystes Congenitaux, by PROF. LANNELONGUE (Paris, 1886). A valuable and exhaustive monograph upon congenital cysts. The first part deals with dermoid cysts, the second with mucoid, and the third with serous cysts. The mucoid tumors are regarded as belonging to the dermoid series.

The anatomy of the serous cysts is very fully given. The author believes that some are altered angeioma, while the majority are of lymphatic origin. The fourth section of the work deals with cysts not included under the above headings—*e. g.*, hydronephrosis, sacro-coccygeal tumors, etc.

Des Luxations Pathologiques, by MM. FORGUE and MAUBRAC (Paris, 1886). This laborious work discusses the whole subject of pathological dislocations, their etiology, pathology, and anatomy. Tho mechanical causes that produce deformity on the various points are fully considered. The authors have produced a very complex classification of pathological luxations, that will probably not commend itself either to pathologists or to surgeons. The work is exhaustive and up to date, but adds little to our present knowledge.

Krankheiten der Nase, ihren Nebenhölen und des Rachens, by DR. G. SCHEFF (Berlin, 1886). This is an ambitious work upon diseases of the nose and pharynx. It aims at being complete, and professes to cover the whole subject of pathology, diagnosis, and treatment. The author attempts—with poor success—to consider, apart from one another, the affections of the nose and of the pharynx. The work is of unequal merit, the best and most exhaustive chapters—and at the same time the least useful—are upon the subject of deformities of the nose and rhinoplasty.

Die Lehre von der Brucheinklemmung, by DR. F. REICHEL (Stuttgart, 1886). A very valuable and original contribution to the subject of intestinal obstruction. The first part deals with an analysis of 160 cases of strangulated hernia. The second part enters fully into the whole of the vexed question of the mechanical causes of obstruction of the lumen of the strangulated bowel. The paper is an elaborate one, illustrated by ingenious original experiments.

Über die Behandlungsmethode der Prostatitis mit besonderer Berücksichtigung der Prostate Hypertrophie, by L. FISCHER (Munich, 1886). The work commences with an account of the various forms of prostatitis, their pathology, diagnosis, and treatment. It then considers prostatic abscess, prostatic hypertrophy, retention from prostatic enlargement, and kindred subjects. A very good account is furnished of these affections, and although the monograph cannot lay claim to much originality, it may be regarded as one of the best works we possess upon the surgery of the prostatic region.

TETANUS.

The nature of tetanus was one of the subjects chosen for discussion at the recent Congrès Français de Chirurgie (*Revue de Chirurgie*, No. 11, 1886). The following is a brief account of the conclusions of the various speakers:

M. VASLIN gave an account of 17 cases with 1 recovery. He regarded the disease as of nerve origin ("une surexcitation nerveuse"). He had injected the blood and urine of patients who had died of tetanus into animals, but no result had followed. He advised perfect isolation and the use of chloral and morphia in large doses.

M. BALESTRERI also considered the disease to be a pure neurosis. He uses tartar emetic, beginning with a dose of five centigrammes (about one

grain) and increasing the amount gradually until the patient is taking thirty to forty centigrammes every day. 3 cases were treated by this drug and all recovered; 17 cases were treated with chloral and only 6 recovered.

M. THIRIAR would class tetanus with the infective diseases. He gave details of 4 cases to support his view.

M. MANORY believed the disease to be contagious, but also considered that cold and other climacteric changes were concerned in the etiology.

M. DOYEN considered tetanus to be a form of septicæmia. In fatal cases he had found micrococci in the brain, the liver, and the blood. He considered that they had spread from the wound, chiefly along the sheaths of the lymph vessels and the nerves.

PROF. VERNEUIL argued the hypothesis that the disease has an animal origin and is derived from the horse. He believed that tetanus is always a specific infectious malady, probably conveyed from one subject to another by a specific microbe. He gave facts to support his view that the disease is derived from horses, stating that tetanus is peculiarly frequent in those who attend horses, and most apt to occur after horse-bites. Direct infection from tetanic horses has been proved.

M. LARGER gave illustrations to prove that tetanus is an infectious and contagious disease; while DR. BLANC (a physician from Bombay) considered that the disease is, like cholera, greatly influenced by seasons and climate. He regarded cold and wet as probable factors. He considered that a specific germ may exist, and that infection is conveyed, as in cholera, probably through the water.

DR. HILLER (*Centralblatt für Chirurgie*, 1886, No. 48) claims that there is a certain resemblance between tetanus and heat apoplexy. Both affections are marked by high temperature, and, indeed, some of the highest recorded temperatures have been met with in these two disorders. He considers that the great body heat is due to the muscular contractions, and that the essential feature in treatment should be the withdrawal of some of that heat. He advises that tetanus be treated by cool baths and by antipyrin or thallin in large and repeated doses. The action of the skin should be increased by pilocarpin.

THE TREATMENT OF MALIGNANT PUSTULE.

DR. INDUTNJII (*Russkaja Medizina*, 1886, No. 20) strongly recommends the treatment introduced in 1884 by Scharnowskji. This consists in the hypodermatic injection of a two per cent. solution of carbolic acid. The injections are made from two to three times daily. The sore is covered with a compress of carbolic lotion, and quinine is administered internally. Of six cases treated in this manner, only one died. In this instance the pustule was situated on the lip, and the treatment was commenced too late. The use of a hypodermatic injection of a warm one per cent. solution of salicylic acid has also been attended with good results.

DR. SLESSAREWSKJI (*Ibid.*, No. 30) treats malignant pustule with corrosive sublimate. His paper deals with 63 cases. Of this number, only 2 died. One of the fatal cases did not come under treatment until the seventh day, and the other died on the sixth day of the disease with severe gastro-intestinal catarrh. Of the 61 cases that recovered, 1 was seen on the first day, and 1

on the fifth, 22 came under notice on the second day, 30 on the third day, and 7 on the fourth day.

The pustule was seated upon the face in 6 cases, upon the neck in 21, and upon other parts of the body in 34.

44 of the cases were treated in the following manner: The surface of the pustule is cut away with a scalpel and the raw area is then dusted with corrosive sublimate in powder. Quinine is given internally. A slough forms at the site of the pustule which separates in about ten days. In no instance were symptoms of poisoning produced.

In 11 instances salicylic acid in powder was applied in the same manner, but it is apparently less efficacious.

In 5 cases the pustule was destroyed by the actual cautery, and in one example the carbolic acid treatment (Scharnowskji) was employed.

Drs. Woronzoff, Winoggradof, and Kolesnikoff (*Ibid.*, No. 32) have performed a series of elaborate experiments upon animals with a view of ascertaining the best means of destroying the virus of malignant pustule.

They treated the fresh blood and portions of the skin of animals that had died of malignant pustule, with various disinfecting solutions, and then inoculated healthy animals from the tissues so treated. 0.2 per cent. solution of corrosive sublimate, 5 per cent. solution of carbolic acid, and 4 per cent. solution of salicylic acid, rendered the diseased tissues harmless in a comparatively short time. Chlorate of lime and solutions of tannin and chloral hydrate were useless. Of the disinfectants used, corrosive sublimate was the most rapid and the most complete in its action.

Chian Turpentine in Cancer.

Dr. John Clay (*Lancet*, 1886, vol. ii. p. 720) states that since his first communication on this subject (six years ago) he has treated and cured a number of cases of epithelial cancer by means of Chian turpentine. He gives three typical examples: 1. Epithelioma of tongue. Male, aged fifty-nine. Ulcer of four months duration, the size of a sixpenny piece, and surrounded by much induration. One enlarged submaxillary gland the size of a pullet's egg. Movements of tongue limited. No history of syphilis. Treatment: Chian turpentine mixture (Southall's), 8 ounces; resorcin, 2 drachms. Two teaspoonfuls three times daily. The ulcer to be painted on alternate days respectively with chromic acid solution (10 grains to the ounce), and solution of perchloride of mercury (one grain to the ounce). In three months the gland had disappeared, and the ulcer was healed. A new growth appeared on the opposite side of the tongue, associated with another enlarged gland. These both disappeared under continued treatment. In connection with this case, two questions suggest themselves. Are surgeons familiar with bilateral development of epithelioma in the tongue? What interpretation is to be put upon the fact that the second cancer developed when the patient was well under the influence of the drug?

2. Epithelioma of upper lip. Female, aged fifty-two. No history of syphilis. A fungating indurated growth of irregular outline had occupied the whole of the upper lip and involved the lower portion of the left ala nasi; duration of disease not mentioned. A piece examined under the microscope in the fresh

state showed epithelial nests. At the end of thirteen weeks the mass sloughed out or "separated;" a good cicatrix followed. The microscopic examination in this case is unsatisfactory. The comparative rarity of epithelioma of the lip—and especially of the upper lip—in females must be noted, and also the peculiar extension of the disease in this instance. There is no mention of gland enlargement.

3. Epithelioma of the os and cervix uteri. Age, fifty-four. Watery and sanguineous discharges for several weeks. Emaciated and cachectic. The epitheliomatous growth was the size of a hen's egg. After seven weeks of treatment, the growth had almost disappeared. A complete recovery resulted.

MR. BURY (*Ibid.*, p. 895) reports a case of cancer of the os uteri (in a patient aged forty-nine) cured by the use of Chian turpentine. Symptoms had existed for six months. He also records an instance of long-standing cancer of the breast that underwent improvement while it was being administered.

EPHEMERAL GLYCOSURIA IN SURGICAL PRACTICE.

DR. REDARD has published a paper upon this subject in the *Revue de Chirurgie*, 1886, Nos. 9 and 10, the following excellent abstract of which appears in the *London Medical Record* for December, 1886.

Ephemeral glycosuria frequently occurs in surgical practice. It is in some instances accompanied by ephemeral albuminuria, and very often the albumen is replaced by sugar, and *vice versâ*. It is not rare to find that sugar appears in the urine several times in the course of the affection. From the author's experience, ephemeral glycosuria is almost always accompanied by transient polyuria and an increase in the quantity of urea. The quantity of sugar which is proportionate to the gravity of the case varies to a considerable extent in different cases. The surgical affections in which this complication has been observed are extremely varied. It was often noted after slight injuries and subcutaneous fractures, but occurs, the author states, much more frequently and, indeed, almost constantly during phlegmonous and gangrenous affections, anthrax, lymphangitis, and erysipelas, and presents itself in a most marked degree in a great number of cases of suppuration just at the time of the formation of an abscess. The author's cases show that there exists a decided relation between the formation of the pus and the appearance of the glycosuria. In nearly all the cases of phlegmon, erysipelas, and septicæmia observed by the author, sugar appeared in the urine just as the temperature of the body was suddenly elevated. The affections in which ephemeral glycosuria has been most frequently observed are those of a septicæmic character. It is held that in the great majority of cases reported in this paper, the condition of the urine was a true ephemeral glycosuria, analogous to the ephemeral albuminuria recently observed in the course of certain medical affections. There was no history of diabetes. Of many patients who were observed from time to time after cure of the surgical affections, not one presented glycosuria or any other sign of diabetes. It is necessary, however, in order to distinguish ephemeral glycosuria from true diabetes, to continue for some time the daily examination of the urine. In attempting to account for the appearance of sugar in the urine at certain times in the course of some surgical affections, the author suggests that the impression produced at the periphery by a cuta-

neous inflammation, or some other local morbid condition, might be transmitted to the vasomotor fibres contained in the splanchnic nerves and so cause hyperæmia of certain organs, especially the liver and lungs, and accelerate the transformation of glycogen into sugar, thus giving rise to glycosuria. By this theory might be explained also the instances of ephemeral glycosuria and albuminuria that have been observed in the course of some medical affections and after irritation of the skin. Glycosuria, when occurring at an advanced stage of certain surgical affections in association with congestion of the lungs, might be considered as asphyxic and due to the phenomena of insufficiency of oxygenation of the blood. The author would rather admit that the asphyxic blood acts as an irritant and excites the liver to discharge a larger quantity of sugar into the circulation. This irritation may act directly on the liver, but more likely is transmitted by the great sympathetic of the vagi nerves from the cerebro-spinal nervous system. In concluding his paper the author states that these numerous theories might explain ephemeral glycosuria, but that none of them are entirely satisfactory and applicable to every case. Too much at present remains unknown for a complete solution of the problem.

The Treatment of Cold Abscess.

Dr. Andrassy (*Brun's Beiträge zur klinische Chirurgie*, Bd. ii. S. 311) advises the treatment of cold abscess by means of injections of iodoform. He injects the following mixture into the abscess cavity: Iodoform 10 parts, glycerine 50 parts, water 50 parts. He makes two or three injections, as a rule, at intervals of about fourteen days, and obtains a cure by this means in from four to five weeks.

He has treated 22 cases of cold abscess by this injection, and in 20 a speedy and a perfect cure followed. In no instance were any of the phenomena of iodoform poisoning produced. The method appears to be well adapted for large abscesses.

The Treatment of Varicose Veins.

Surgeon-Major Stevenson (*Lancet*, 1886, vol. ii. p. 709) gives his experience of the treatment of varicose veins by the injection of carbolic acid—a measure advocated by Mr. Watson Cheyne.

The treatment consists in the injection of one minim of pure carbolic acid at different situations into the enlarged veins, having previously cut off the circulation from the limb by means of an elastic bandage placed above the highest point of puncture. Injections of pure carbolic acid, one minim each, are then made into the veins at about one inch and a half apart—as many as may be required for each case. A little pledget of absorbent carbolized cotton-wool is placed over each puncture as the needle is withdrawn, and well soaked with collodion; this is allowed to remain until, in the course of time, it falls off, when healing will usually be found completed. The elastic bandage should not be removed in less than fifteen minutes after the last injection has been made, and great care should then be taken not to remove it suddenly. For at least a week after the operation the patient should not assume the erect position or put his foot to the ground for any purpose whatever. The pain is very slight and no anæsthetic is required. "I have done," writes the

author, "as many as eighteen injections in one case; and it seems to me advisable to begin with the injection next to the elastic bandage—that is, the one highest on the limb. Getting the point of the needle well into the vein is not quite so easy a matter as might at first appear; attempts to do so at right angles to it frequently fail, and the injection is thus made into the surrounding tissue. The best plan is to fix the skin over the vessel by means of the left thumb, close below the point selected for puncture, and to direct the needle through the skin and coats of the vein in the long axis of the latter. I should think that, in my cases, somewhere about ten per cent. of the punctures caused suppuration, a little abscess about the size of a pea forming where this occurred; but this process, as the result of the caustic action of carbolic acid, was curiously slow and almost absolutely painless."

Dr. Stevenson has treated eight cases by this method with in each instance a certain and permanent good result. On theoretical grounds the procedure should involve some risk. It may be a question also, whether the results will always be so satisfactory as the small number of cases show.

Strong arguments must be adduced to persuade surgeons to abandon the certainly most successful operation of excision for these cases.

Dislocation of the Hip.

Professor Humphry (*Lancet*, 1886, vol. ii. pp. 1011, 1247) has published a most important paper on this subject. He deals with the dorsal dislocation, and founds his remarks upon the detailed dissection of three specimens and upon certain experiments upon the cadaver. "I think," he writes, "it is certain that in each of these three cases the head of the femur passed out of the acetabulum, not at the notch where the capsular ligament is weakest and the resistance to its escape is least, but further back, opposite the tuber ischii, at the part where the rent in the capsule radiates in three directions, and where, accordingly, the first strain upon the capsule must have been greatest. In the first and second cases this was just below the level of the obturator internus and the gemelli. In the third case it must have been rather higher —*i. e.*, beneath the obturator internus, the tendons of which were torn away from the muscle by the force of the head of the bone thrust out beneath it. All three cases were, in short, examples of direct dislocation, and in none of them was the cotyloid ligament or the margin of the acetabulum injured. It has been maintained, upon sufficient grounds, I think, that the dislocations of the hip backward are always, or almost always, indirect, that the head of the bone escapes from the acetabulum close to the transverse ligament, and is then, if the limb be in an inverted position, carried backward and perhaps upward. Furthermore, it is held that the accident occurs during the abducted position of the limb. I quite grant that the capsule is weakest and least supported by muscles in this situation, and that dislocation is easily caused here, in the dead body, by forcible abduction of the limb. But it is to be remembered that the capsule is weakest here, because in the living body it is least liable to be strained in this direction."

Professor Humphry maintains: 1. That the position of the rent in the capsule, through which the head of the bone escapes from the acetabulum, is not at the lowest part, but at the lower and back part, behind the pubo-femoral

ligament. 2. That the dislocation occurs commonly when the limb is adducted, flexed, and inverted, and not when it is abducted. 3. That the dislocation is direct, and not indirect. Professor Humphry states that in most recorded cases the limb appears to have been in the position of adduction at the time of the accident, and that the method of reduction by manipulation supports his view as to the course followed by the bone in its escape.

Mr. Henry Morris (*Ibid.*, p. 1165) directly confutes Professor Humphry's conclusions, and maintains that the rent is in the lowest part of the capsule, that the dislocation is indirect, and that it really occurs when the limb is in the position of abduction. Mr. Morris believes that the recorded cases demonstrate that the accident most commonly happens when the limb is in the position named, and that the method of reduction by manipulation supports his conclusions.

Mr. Morris does not differ—except upon the question of the position of the rent in the capsule—from Professor Humphry upon the anatomical data of the lesion, but he cannot accept the interpretation placed upon these facts. The two papers furnish the most valuable contribution to this subject, and the weight of evidence so far appears to incline to the side taken by Mr. Morris.

Gangrene of Limbs.

Dr. Scott Lang (*Edinburgh Medical Journal*, January, 1887) has published a paper with this title, "To Ascertain whether Gangrene is likely to Follow Severe Injury of a Limb." The author recommends the following method: "Gently raise the limb, and keep it raised for two or three minutes, in order to empty it to some extent of blood. Then apply a tourniquet or piece of elastic webbing on the proximal side of the injury, and keep it applied for about a minute. Lower the limb, remove the tourniquet, and, if sufficient circulation remains, the part beyond the seat of injury will blush very red, and will show in an unmistakable manner the condition of the bloodvessels."

Gaseous Tumors of the Neck.

Dr. Paul Fabre (*Gaz. Méd. de Paris*, 1886, p. 373) reports the following cases: (1) A female child, aged two and a half months, had bronchitis. On the third day a swelling was noticed in the right supraclavicular region. There had been no injury. The tumor had all the characters of an emphysematous swelling. It was increased by coughing, and also during crying. As the cough subsided the tumor slowly disappeared. The author surmises that the swelling was due to rupture of the thyro-hyoid membrane, a diagnosis that does not commend itself.

(2) A male child, aged one month, with a congenital tumor in the front of the neck. The tumor contained air, and subsided quickly and entirely at each inspiration, swelling out again at each expiration. It was the size of a goose's-egg, and was covered with normal integument. The upper part of the sternum was absent. Indeed, no part of that bone could be made out above the level of the fifth costal cartilage. The first ribs appeared to have joined across the median line. It is evident that the wall of the trachea was deficient. The clavicles were normal. The author concludes with an account of other reputed cases of cervical tumor containing air.

M. GIRAUD (*Revue de Chirurgie*, No. 11, 1886), under the title of "Trachéole," reports the following case: A woman, aged forty-one, was stabbed in the neck with a knife. The stab was deep and involved the air-passage. The wound healed well. After cicatrization the patient developed a cough, and under the scar a tumor containing air slowly made its appearance. It was on the left side, was the size of an orange, and had the shape and site of a goitre. It was barely to be seen during inspiration, but at once swelled out on coughing. It was evidently due to hernia of the tracheal mucous membrane, and communicated with the trachea. To the paper is appended an exhaustive account of the reported examples of aërial cervical tumors.

MR WHEELER (*Dublin Journal of Medical Science*, November, 1886) reports, under the title of "Pharyngocele," the following remarkable case: A man, aged fifty-seven, suffered from recurrent attacks of bronchitis, laryngitis, and tonsillitis. On lying down he was troubled by a sense of choking, as if a solid mass occupied the throat. His speech was indistinct. He suffered from intense fits of coughing and dysphagia. A tumor existed in the right submaxillary region, that varied in size and was tympanitic on percussion. It proved to be a diverticulum formed from the pharyngeal mucous membrane. The swelling was exposed, a piece of the wall of the hernia-like cul-de-sac was removed, and the wound thus made closed by sutures. The patient made a speedy and complete recovery. Mr. Wheeler believes this to be the first case of pharyngocele cured by operation.

TONSILLAR CALCULI.

PROF. TERILLON has published (*Archives Générales de Mèdecine*, August, 1886) an elaborate paper upon the subject.

The subjects of tonsillar calculus are liable to repeated attacks of sore throat, associated with much œdema of surrounding parts, and ending in abscess, with usually the discharge of some concretions.

The persistence of these attacks and their frequent repetition should suggest calculus, and the stone can often be detected at the bottom of the ulcer left by the bursting of one of the abscesses.

The calculi are hard and white and often deeply imbedded; their early removal is important, and effected without difficulty.

INTRAGLANDULAR EXTIRPATION OF GOITRE.

In the place of total extirpation of the thyroid body, DR. GARRÉ (*Centralblatt für Chirurgie*, No. 45, 1886) advises the shelling out of the degenerated portion of the gland. In many examples of goitre the disease occurs in the form of circumscribed masses, each of which is separated from the healthy thyroid by a more or less defined capsule.

The capsule is recognized by its regular outline and pale, bluish, transparent wall. Dr. Garré acknowledges that these masses may, especially when deep, be difficult to find, and their removal may involve a deep wound in the vascular thyroid. When once discovered, they are readily shelled out by the finger or some blunt instrument. The bleeding is said to be of no great moment. The cavity left after the extirpation of one or more of the masses is drained.

The operation has been performed in fifty cases by Professor Socin with good results, and without the danger and deformity that attend the removal of the entire gland.

The Pathology of the Thyroid Gland.

Mr. Victor Horsley (*Lancet*, December, 1886) gives an account of this body that bears in an important manner upon the surgery of the part. He shows that the gland is an excretory, or, rather, a metabolic organ, without being provided with the usual duct of such organs. It also possesses some sort of hæmapoietic function, since the number of red blood-disks in the efferent vein is greater than their number in the afferent artery. Whether the gland exercises any power of forming the fluid portions of the blood must remain at present a doubtful matter. It appears to be a maker of corpuscles only. Mr. Horsley believes that the relation of the thyroid gland to the brain is an apparent and not a real one, and experimental evidence is adduced to prove this position. An adult fox terrier, from whom one lobe of the thyroid gland was removed, was submitted to experimental excitation of the cerebral hemispheres after the expiration of a period of 271 days. An adult black-and-tan dog was similarly the subject of an experiment 109 days after removal of one lobe of the thyroid. Also a bonnet monkey, 84 days after a similar operation. The motor centres of each of these animals were exposed under precisely similar conditions. Excitations with the faradic current were made to each motor part of the hemisphere in each animal, and with the result that no difference could be detected on the two sides. The period of latency, tonic spasm, and clonic spasm—epileptic motor phenomena—were precisely the same whether the right or left hemisphere was stimulated. It was clear then that removal of the one lobe of the thyroid had exerted no detectable influence over the nutrition of the motor cerebral centres on the same side.

Mr. Horsley states that there is no experimental or clinical evidence that the thyroid gland is represented in the cerebral hemispheres. The gland receives from the medulla oblongata sympathetic fibres, which pass down the cervical part of the spinal cord as far as the eighth cervical nerve, and then leave the cord and proceed upward in a direction almost parallel to their former direction in the cord, and are distributed to the glands along the arterial vessels. The gland appears also to receive nerve fibres from the recurrent laryngeal nerve, which are probably derived from the motor nucleus of the spinal accessory.

In order to place on an experimental basis the subject of innervation of the gland, Mr. Horsley performed two experiments on dogs. In each dog an inch of the recurrent laryngeal nerve was excised on one side. One dog was kept alive nine and the other eleven months. But there was no histological difference to be detected between the lobes of the thyroid in either case.

The following experiments, to illustrate the comparative pathology of the thyroid, are interesting.

The suggestion is made that where the glands and acini are small, functional activity is slight. One experiment was made on a donkey. The thyroid gland was excised in August, 1885, and the animal died in 205 days. The chief symptoms for two months were emaciation and weakness; the mental hebetude, if any, was difficult to gauge; the temperature of its body was but

slightly lowered. In March, 1886, when the weather became severely cold, nervous symptoms suddenly supervened, and tremors were observed for three days, chiefly in the muscles of the head and neck. On the fourth day these were complicated by constant twitching; the animal became so weak as to be unable to stand, and the body temperature became markedly lowered. Later still, muscular rigidity was observed, and also the paralysis increased, especially in the jaw. On the fifth day of the cold weather the donkey became much worse, and died in the morning. This experiment seemed to show that the gland in the donkey was of but relatively little importance, and the case also brought out very clearly the malignant influence of cold when the thyroid gland was inactive or had been altogether removed. Two experiments had been made in sheep, which have a comparatively good-sized thyroid gland, but though the operation was performed in October, 1885, the animals were still well. In two pigs, the removal of the thyroid was followed by characteristic symptoms of tremors, leucocytosis, and anæmia, with subnormal temperature.

Rupture of the Bladder.

Sir William MacCormac (*Lancet*, December 11, 1886) contributes an account of two cases. In both the rupture was intraperitoneal. The author draws attention to the rarity of the accident, and to the great mortality that attends it, and gives an excellent account of the literature of the subject.

The first patient was a man, aged thirty-five, who was struck violently on the abdomen. He walked home—a distance of 250 yards. The symptoms were vomiting, pain, strangury, with inability to pass water. The man was sober, and had emptied his bladder an hour and a half before the accident. He was admitted fifteen hours and a half after the injury. A catheter was passed, and one and a half ounces of blood and urine drawn off. Laparotomy was performed. The rent in the bladder was on the posterior aspect, was median and vertical, four inches in length, and extended from the superior fundus to the recto-vesical cul-de-sac.

Sixteen silk sutures—involving the serous and muscular coats—were introduced according to Lembert's method; and six catgut sutures that involved the peritoneum only. The peritoneal cavity was washed out with a solution of boric acid. A glass drainage tube was introduced, and a catheter tied in the bladder. The operation was performed under antiseptic precautions, and occupied two hours. The patient made an excellent recovery.

The second case was that of a man, aged thirty-seven, who fell a distance of eighteen or twenty feet, in a sitting posture, upon soft clay. The man was sober, and the bladder had been emptied one and a half hours before the accident. Laparotomy was performed twenty-seven hours after the injury. The rent was two inches in length, and was placed obliquely on the upper and posterior part of the bladder. Fifty ounces of serum and urine escaped from the peritoneal cavity. The case was treated in the same manner as the above, twelve sutures being employed. The patient made a rapid recovery.

Both patients were fat, heavy men. In neither was there any collapse. Sir William MacCormac gives an account of the various operative procedures that have been devised and practised for the relief of this injury.

Drs. Brown and McGill (*Ibid.*, Nov. 20, 1886, p. 971) record two examples of rupture of the bladder. The first patient was a man, aged twenty-six, whose bladder gave way while straining at stool. A catheter was passed, and four ounces of urine drawn off with some blood-clot. A trocar was introduced midway between the umbilicus and pubes, through which much urine drained.

The day after the accident the bladder was opened by a median perineal incision, and a drainage tube introduced. The man died shortly after the operation. The post-mortem revealed peritonitis, and a small rupture—capable of admitting the forefinger—was found at the posterior surface of the bladder, outside the peritoneum.

The second patient was a man, aged fifty-four, who was knocked down when running. He had been drinking. A catheter drew off a quarter of a pint of bloody urine. On the fourth day after the accident laparotomy was performed. A large rent was discovered in the posterior wall of the bladder involving the peritoneum. The viscus was brought into better view by distending the rectum with an air tampon. The bladder wound was closed by sutures. The patient died next day.

Dr. Armstrong (*Ibid.*, Nov. 13, 1886) records a case of recovery. The patient was a girl of sixteen, who fell from a window into the street. She was much collapsed, was severely bruised, and was found to have sustained a fracture of the astragalus and of other bones. Bloody urine was drawn off by catheter. An irregular rent, four inches long, was found in the anterior wall of the vagina involving the bladder. This wound was at once carefully closed by sutures. The patient made a sound recovery. Dr. Armstrong regards the case as an example of rupture of the empty bladder by indirect violence.

Litholapaxy in Male Children.

Surgeon-Major Keegan (*Lancet*, 1886, vol. ii. pp. 1068 *et seq.*) gives an account of 58 litholapaxies performed on boys at the Nidore Hospital, Central India. The ages of the patients varied from one and three-quarters years to fourteen years. The size of the lithotrite used was between No. 7 and No. 11. The stones were of all kinds. The heaviest weighed 700 grains. It was a uric acid stone with a nucleus of oxalate of lime and a covering of phosphates. The patient was nine and a half years of age; symptoms had existed for two years. The operation was performed at one sitting and occupied 182 minutes. The lithotrite was introduced twenty-six times. The patient was in the hospital ten days and made a good recovery. Other stones weighed 360, 344, and 285 grains. In only one instance did death follow. The operation was successful in 57 of the cases. Dr. Keegan greatly prefers litholapaxy to lateral lithotomy for male children. Lithotrity he justly condemns. He examines the objections to litholapaxy in children, the chief being the smallness of the bladder, the narrowness of the urethra, and the great sensitiveness of the genital-urinary mucous membranes. He states, in answer to these objections, that he has never found the size of the bladder an obstacle to the operation, and he does not think that he has ever damaged the mucous membrane of the urethra or bladder.

With regard to the calibre of the urethra, Dr. Keegan states that he has never found any difficulty in introducing the instrument. The meatus may

often have to be incised, but the canal itself is much larger in boys than is supposed. As a rule, the urethra of a boy from three to six years of age will admit of No. 7 and No. 8 lithotrite (English scale); while the urethra of a boy of eight or ten years of age will admit a No. 11, a No. 12, and even sometimes a No. 14 lithotrite.

In one child, aged two, a No. 7 lithotrite was used and a No. 9 catheter. In another child aged one year and nine months, a No. 7 lithotrite was employed.

The paper enters into details of the chief cases, and forms a most valuable and practical addition to this branch of operative surgery.

A New Method of Exposing the Kidney.

Professor König (*Centralblatt für Chirurgie*, 1886, No. 35) advises the following operative procedure. The incision is carried at first downward from the last rib to a point a little above the iliac crest and near the outer margin of the erector spinæ. It is then directed upward in a curved manner as far as the outer border of the rectus muscle, about the level of the umbilicus.

The muscles exposed by this double incision—which is increased in extent when necessary—are next divided and the kidney exposed behind the peritoneum, which is stripped from it. If it be desirable for any reason to approach the kidney from the abdominal cavity, the peritoneum is divided along the course of the oblique anterior incision. If the kidney so exposed contain pus, it is advised that the wound in the peritoneum should be closed when the organ has been freed and before it is cut into.

The author gives two examples of this latter procedure, both of which were successful. One concerned a case of renal calculus, the other a suppurative pyelonephritis. After the kidney has been dealt with, various layers of divided muscle must be united by sutures in their proper order. In order to facilitate this step, Professor König advises that a suture be passed through each divided muscle as it is incised. The sutures are retained for three weeks and the patient kept in bed for at least four weeks after the operation.

Hepatic Surgery.

Dr. George Harley (*Brit. Med. Journ.*, 1886, vol. ii. p. 899) gives an account of an operation he terms "hepatic phlebotomy." He points out that neither cutting nor leeching the abdominal parietes can have any direct effect on the amount of blood present in an inflamed liver, since no direct communication exists between the bloodvessels of the abdominal walls and those of the hepatic organ.

He advises the direct tapping of the liver to relieve certain cases of engorgement and inflammation: and draws attention to the harmlessness of this operation in healthy animals. He gives the case of a woman of intemperate habits, aged thirty-eight, who was suffering from severe hepatitis with dropsy. The patient was anæsthetized and the upper part of the liver was pierced from right to left with an eight-inch trocar of a diameter between a No. 2 and No. 3 English catheter. Twenty ounces of blood were allowed to escape, the trocar having been driven in up to the hilt. An excellent result followed. He also advises puncturing of the liver capsule as a remedial measure in cases of chronic congestive hypertrophy, and gives examples of this mode of treatment.

MR. KNOWSLEY THORNTON (*Ibid.*, p. 901) gives details of a series of cases of operation upon the liver including the evacuation of hepatic abscess, of suppurating hydatid cysts, and the removal of gall-stones. In one case of non-suppurating hydatid cyst, the cavity was sponged out with tincture of iodine and allowed to close.

MR. WILLETT (*Ibid.*, p. 903) reports a case of cholecystotomy in a woman, aged fifty-two. The incision was three inches long and was made in the right semilunar line. The bile-duct was found occluded by a chronic inflammatory stenosis. The gall-bladder was distended, but contained no gall-stone, neither was any growth found in its vicinity. Its walls—after opening—were stitched to the abdominal parietes. The patient recovered with a biliary fistula.

MR. HOWARD MARSH (*Ibid.*, p. 905) deals with a case of hepatic abscess in a boy aged eleven and one-half years. The abscess was opened and drained and the edges of the wound stitched to the abdominal wall. Thirty-six ounces of pus escaped. The patient recovered with a biliary fistula.

MR. LAWSON TAIT (*Ibid.*, p. 905) reports a remarkable series of 50 cases of operation on the liver. In 7 exploratory incisions were made, the cases being chiefly instances of tumor of the liver. In 13 instances laparotomy was performed, for the most part for the relief of hydatid cyst. In the remaining 30 cases the operation of cholecystotomy was carried out. Out of this number of 50 cases, only 2 died of the operation. Details are given of some of the more important examples.

M. POULET (*Bull. et Mém. de la Soc. de Chir.*, Paris, t. xii. p. 129) reports one case of hydatid cyst of the liver treated by operation. He advises incision in the place of puncture, the removal of as much of the sac as possible, and stitching of its margins to the edges of the divided peritoneum.

OPERATION FOR FECAL ACCUMULATION.

DR. P. MORRIS (*Brit. Med. Journ.*, December 18, 1886) reports this case.

The patient, a woman, aged twenty-four, was the subject of intestinal obstruction due to the above cause. The symptoms were chronic. Hard masses were felt in the abdomen. The rectum was blocked with feces, the removal of which led to no improvement. Enemata were unavailing. Vomiting became distressing, and the patient much emaciated.

The patient being anæsthetized, the whole of the tissues of the anus back to the coccyx were divided, in order that the hand might be freely introduced into the bowel. By the side of the hand a long tube was passed, through which warm soaped water was injected. Dr. Morris thus continues: "At the top of the pelvis I came across the big mass which I had so often felt and vainly attempted to remove; but now I could easily crush it. The arm was now withdrawn, when the whole was expelled. After reintroducing the arm I found that the colon was in a very abnormal condition, because, instead of there being an ascending, transverse, and descending colon, it was one tremendously distended chamber, and with my whole arm introduced up to the axilla, I could, on account of her great emaciation, investigate and manipulate every part of the abdominal cavity, with the other hand externally. Strange to say, in the neighborhood of the right iliac fossa I found an oval opening large enough to allow the passage of a good-sized plum (an inch and a half

long), with a well-defined margin. This was plugged with a lump of hard fecal matter, which was removed and crushed." Dr. Morris supposes this opening to have been the ileocæcal valve. The colon having been well cleared out, the perineal wound was sutured. An excellent recovery followed.

There is no clear evidence to show that the colon was arranged as Dr. Morris assumes. If the colon be distended, it will become enlarged in both its transverse and longitudinal axes, and will probably measure not less than six feet. This distance can hardly have been traversed. Dr. Morris appears to have explored and evacuated a very large sigmoid flexure, the summit of which when distended may reach to the diaphragm. The deformity of the colon alluded to is not familiar to anatomists, and the opening supposed to be the valve was of unusual dimensions. The operation was admirably planned and carried out.

Intussusception with Malignant Disease.

Dr. Kulenkampff (*Centralblatt für Chirurgie*, No. 47, 1886) reports the following case: A woman, aged thirty-nine, had suffered from partial obstruction of the bowels with a bloody discharge from the anus for six months. In due course a mass, considered to be a polyp, could be felt in the rectum. This proved to be a papillomatous (and probably malignant) growth that took origin in the sigmoid flexure, and had led to an invagination of that part of the colon into the rectum. The entire mass, together with the intussusception, was removed through the rectum. An adherent coil of bowel was accidentally wounded, and the wound was closed by sutures. Symptoms of obstruction set in, and on the tenth day after the operation laparotomy had to be performed and an artificial anus made on the left side. The patient recovered, but with a fecal fistula.

The following recent papers may be noted:

"Hemorrhage from the Innominate after Tracheotomy," by Dr. Hutton (*Brit. Med. Journ.*, December 4, 1886, p. 1102). A boy, aged one and a half years. Operation for laryngitis of three weeks standing. Death from bleeding on the twelfth day. An ulcer was found on the anterior wall of the trachea, at the level of the lower end of the tracheotomy tube, that had opened the innominate artery.

"Acute Peritonitis Treated by Laparotomy," by John Taylor (*Brit. Med. Journ.*, December 18, 1886, p. 1212). Female, aged twenty-one. Recurrent febrile attacks with left iliac pain following labor. Seven weeks after labor, acute general peritonitis. Laparotomy. A burst pelvic abscess found. Abscess sac removed, peritoneum washed out. Recovery.

"Bacteriology in its Relations to Surgery," by Henry Power (*Lancet*, 1886, vol. ii. p. 1111). This paper, delivered as the Bradshawe Lecture, gives a masterly exposition of the present state of our knowledge on this subject. See also "Microörganisms in Relation to Surgery," by Dr. Heuston (*Dublin Journal of Med. Science*, January, 1887).

"Resection of the Knee," by M. Lucas-Championnère (*Revue de Chirurgie*, January, 1887). A report of eleven examples of the operation performed in adults. Ten for tubercular arthritis, and one for arthritis deformans. In all

an excellent result followed. The paper is illustrated by figures of the special splints and drainage tubes used.

"Hydatids in Bone," by Professor Müller (*Beitr. zur Klin. Chir. Tübingen*, 1886). Case of hydatid cyst in the humerus. An analysis of forty-three recorded cases, with a full account of the clinical history, prognosis, and treatment of this rare condition. A valuable monograph.

"Extroversion of the Bladder," by M. Richelot (*L'Union Médicale*, October, 1886). A useful description of the procedure known as "Le Fort's modification of Wood's operation."

"What Constitutes Malignancy?" by Herbert Snow (*Lancet*, 1886, vol. ii. pp. 719, 770). The author enters largely into the microscopical anatomy of malignant tumors, and concludes with these words: "Briefly to sum up what I have said, the phenomena of malignancy result from conditions which irritate normal protoplasm, cause it to proliferate abnormally, and to assume quasi-independent parasitic vitality. These conditions may be mechanical; in a much larger proportion of cases they are neurotic."

"Acute Glossitis," by Dr. Totherick (*Lancet*, 1886, vol. ii. p. 724). A report of two cases. The patients were males, ages twenty-one and twenty-seven. The attack appears to have been of spontaneous origin in each instance. The cases occurred in the month of July. Dr. Totherick gives an account of the literature of the subject and of the symptoms of this rare disease.

"Rupture of Synovial Membrane of Knee," by M. Pruvost (*France Méd.*, 1886, No. 85). Man, aged forty-five, with gonorrhœal rheumatism. Great distention of knee-joint. During abrupt movement in bed sudden disappearance of swelling and pain. Supposed spontaneous rupture of synovial membrane.

"Traumatic Tetanus Cured by Removal of Cicatrix and the surrounding Parts," by Mr. Cotterill (*Lancet*, January 1, 1887). Man, aged thirty-nine, wound of thumb with broken glass. Tetanus on twelfth day; chloral, potass. bromide, eserine, etc., had no effect. Scar and parts around excised on the twenty-second day of the tetanus: immediate improvement and recovery.

"Surgical Mishaps," by Pridgin Teale (*Lancet*, January 1, 1887). 1. Disappearance of tumor after ineffectual attempts at removal. 2. Chronic inversion of uterus: attempted taxis: laceration of vagina into Douglas's pouch. 3. Wound of popliteal artery and vein during an operation for necrosis. Recovery without gangrene.

"Lipomata of the Hands and Digits," by M. Poulet (*Revue de Chir.*, 1886, No. 8). An account of all the recorded cases of this rare affection, and of the difficulties in the way of diagnosis.

"Congenital Dislocation of the Patella," by Dr. Bessel-Hagen (*Deutsche med. Wochens.*, 1886, No. 3). Three examples of this very uncommon condition, with an account of thirteen other recorded cases. The bone was displaced outward. In some cases the luxation was incomplete; in others, complete and permanent; in a third series complete in the flexed position only.

"Actinomycosis in Man," by Dr. Moosbrugger (*Centralblatt für Chirurgie*, December 25, 1886). An account of ten recent cases and an analysis of the details of no less than seventy-five recorded examples of this disease.

OPHTHALMOLOGY.

UNDER THE CHARGE OF

L. WEBSTER FOX, M.D.,

OPHTHALMIC SURGEON TO THE GERMANTOWN HOSPITAL, PHILADELPHIA.

Extraction of Soft Cataract by Injection.

In 1884 Dr. A. McKeown introduced to the members of the British Medical Association a method of extraction of soft cataract by intracapsular injection of water. In the *British Medical Journal* for January 15, 1887, Charles G. Lee cites six cases operated upon by himself with highly satisfactory results. The method employed is briefly as follows: The operation is preceded by the usual cataract incision at the corneo-scleral margin, and an iridectomy; then a reservoir of water (pure water, not an aseptical solution) is held by an assistant at varying heights above the patient's head, according to force of the stream desired. A simple rubber tubing connects the reservoir with the terminal which conveys the fluid to the parts desired. The terminal is introduced well in the capsule, often right across the area of the pupil to the lower edge of the iris, or wherever cortical matter was seen. It was most interesting to watch the pieces of cortex slowly floating up, sometimes from behind the iris toward the incision, then to escape with the outgoing stream.

Dr. Wicherkiewicz, of Posen, has adopted the principle, and Mr. Edgar Browne spoke favorably of the method as a valuable aid in removing sticky cortex.

Ciliary Correction of Corneal Asymmetry.

In *Annales d'Oculistique* for September and October, 1886, Dr. Georges Martin brings a wealth of clinical support to the thesis of the preceding month. (See *The American Journal of the Medical Sciences* for January, 1887, p. 267.) The most noteworthy practical conclusion is the author's recommendation that when corneal astigmatism is small the total correction may be given at once, but if it is of a medium or large degree it is best to begin with spectacles correcting only the manifest astigmatism, and as the ciliary muscle becomes habited to the new conditions the more complete correction may be successively added until the total astigmatism is neutralized by the lenses. This presupposes an understanding on the part of the patient of the changes to be made, and the assurance that the glasses will be worn without interruption.

In a subsequent chapter the author tabulates and discusses 70 cases in which the ciliary correction of the corneal astigmatism does not stop with the neutralization, but passes over into a condition of over-correction. This, of course, rarely happens; 45 cases occurring out of 3000 examined. The extent of the over-correction runs from 0.25 to 0.75 D.; though exceptional instances run higher. The corneal astigmatism was generally 0.25–0.5 D. The ophthalmometer is alone capable of differentiating the diagnosis. If the over-correction is a recent production, the author advises the persistent use

of atropine for a month; if this fails to break up the over-correction, it may be deemed as permanent, and cylindrical glasses given according to the subjective examination. For chronic cases this is done at once.

Enucleation and Exenteration.

Professor Schweigger's lecture before the Berliner medicinischer Gesellschaft, on the above subject is published in the *Berliner klinische Wochenschrift*, of December 13, 1886. The operation of exenteration is held to be preferable to enucleation in cases where ruptures and wounds of the cornea and sclerotic are of such a nature that suppurative choroiditis and atrophy of the globe are inevitable. In other cases of suppurative choroiditis with inflamed and swollen orbital tissues exenteration is also advised. In sympathetic ophthalmitis resection of the optic nerve is considered better than either enucleation or exenteration. Since 1863 there have been twenty-four fatal results of enucleation, though none have happened in the lecturer's practice, who confesses that he has resorted to the *hässlichen operation* as little as possible. A most urgent and praiseworthy warning is given against the too common haste of enucleation in cases of intraocular tumors. "The more uncertain the diagnosis, the quicker is enucleation proceeded with."

The method of operation in exenteration is to divide the conjunctiva at the corneal margin, excise the cornea, and disembowel the globe with a sharp spoon, leaving only the scleral shell. The conjunctival edges are then sewed together. The time required for healing is greater than in enucleation. A serviceable stump must not be expected, as in a few months the sclerotic will atrophy and shrink to a small and useless relic.

Parasitical Diseases of the Eye.

Professor Zehender's Bowman Lecture before the meeting of the Ophthalmological Society of Great Britain (*The Lancet*, Dec. 4, 1886) reviews those ocular affections that are caused by parasites and microörganisms. Concerning *Filaria loa*, or Guinea worm, the learned lecturer speaks of it as only existing in the eyes of negroes; but the reviewer has been told by missionaries that it infests the eyes of Europeans living in western Africa as well, and we now have a worm three inches long taken from an American gentleman who had lived many years in Guinea. Dr. Reading, of Woodbury, N. J., removed the parasite from the right eye of the patient.

Concerning cysticerci, it is incidentally explained why so many more cases are found in North Germany than in more southern countries. It is because the cysticercus with hooks, the first stage of the tapeworm infesting the human digestive tube, has its habitat in the hog, and pork is more largely an article of diet in North than in South Germany. The successful extraction of thirty in forty-five cases by Alfred Gräfe, of Halle, from 1877 to 1885, is emphasized as proof of the advisability of the procedure; the opening, preceded by a large iridectomy is made through a scleral wound just outside of the corneo-scleral margin.

Of echinococcus hominis, rarely found outside of Iceland, there are at present reports of about forty cases. The antiseptic method of Lister is approved, and phlyctenular conjunctivitis, purulent ophthalmia, trachoma,

saccus lacrymalis, ulcus serpens, keratitis-hypopyon, and keratitis-mycotica are attributed to microörganisms.

Concerning trachoma, besides the standard remedies, the author speaks approvingly of the method of "squeezing, cutting, or scratching out the follicles," as having proved itself useful, and "bacteriologically quite correct."

Etiology of Constitutional Diseases of the Eye.

In the lecture of Tweedy (*Lancet*, January 8, 1887) a valuable distinction is made as to the location of constitutional diseases of the eye. The structures of the eye as developed from the *epiblast*, are the retina and the optic nerve, lens, epidermis, corneal epithelium; those from the *mesoblast* are the fibro-vascular tissues, cornea, sclerotic, iris, choroid, vitreous, capsule of lens, and muscles. Now it is held that the ocular affections due to the strumous diathesis, localize themselves particularly in the epiblastic structures, *e. g.*, the phlyctenular of the epithelium or anterior layers of the cornea, or of the circumcorneal zone of the conjunctiva. The same general class of structures is shown by inflammations dependent upon neuropathic causes, as diseases of the fifth nerve, or herpes; the corneal implication is superficial. But in hereditary syphilis the mesoblastic structures are selected, and in particular the deeper layers of the cornea, the iris, etc. Since, now, drugs seem to have also a selective affinity for special tissue elements, the suggestion follows that with the advance of therapeutic science, this distinction above bespoken will serve as a key to a rational progress in the treatment of ocular diseases.

Neuro-retinitis and Chronic Bright's Disease.

In the *Transactions of the Am. Oph. Soc.*, 1886, Dr. Charles Stedman Bull gives a careful and thorough analysis of 103 cases of Bright's disease, with the retinal manifestations, extending over a space of thirteen and a half years, and constituting about 20 per cent. of the total of such cases under his care during this period. The 80 per cent. not bespoken are the cases whose history subsequent to the first examinations was not recorded; all cases due to scarlet fever or pregnancy were excluded.

The vision was improved by treatment in 32 cases (31.5 per cent.), but the visual improvement (or relapse) was, as a rule, dependent on the changes of the renal disease. There were 46 retinal hemorrhages of both eyes, and in 23 patients the hemorrhages occurred in single eyes. In some cases there was papillitis, without the characteristic retinal exudation, though the exudation appeared later, not necessarily stellate, however. Diminution of the calibre of the retinal arteries was not constant. Absorption of the stellate exudation was never observed, however great the improvement of vision [the Reporter, however, has observed such absorption in some cases]. The author thinks no case of chronic interstitial nephritis is ever cured after cardiac hypertrophy and neuro-retinitis has set in. Attention is called to the unfavorable prognosis in these cases: Of the 103 patients, 86 (over 50 per cent.) died within one year after the first examination, and 18 within the second year; of the 103, only 17 survived at the time of reporting. Dr. Gruening, in the following discussion, stated that out of over 100 cases of his own, none lived over two years after the diagnosis of retinitis albuminurica had been made.

Origin of Choroiditis Disseminata.

In his address before the Section of Ophthalmology, at the annual meeting of the British Medical Association, in Brighton (*British Medical Journal*, Jan. 15, 1887), Mr. Jonathan Hutchinson finds reason to believe in the non-syphilitic origin of certain cases of disseminated choroiditis. The conclusions reached are these:

1. That concussion of the eyeball may produce choroiditis, but limited to the eye injured.

2. That binocular choroiditis disseminata may arise independently of syphilis in association with disorders of the nervous system, especially of the intellect.

3. That young men are liable to a peculiar form of hemorrhagic choroiditis, not dependent on syphilis, producing results indistinguishable from the syphilitic forms.

4. That there are yet other unclassifiable forms of disseminated choroiditis whose results resemble those of syphilis, but where no such disease can be reasonably suspected.

It was, of course, admitted by the lecturer that in nine cases out of ten the choroiditis was due to syphilis, acquired or inherited. The discussion following the lecture was, in general, in accord with the above conclusions. Every speaker seemed to take it for granted that the existence of interstitial keratitis is absolutely conclusive as to the presence of syphilis, an opinion we think also open to doubt. That disseminated choroiditis may arise without syphilis seems to us beyond question.

The Amblyopia of Squint.

Dr. O. F. Wadsworth (*Boston Med. and Surg. Journal*, January 29, 1887) reviews the literature of the theory of *amblyopia ex anopsia*, and from his own cases he concludes against the proposition that the amblyopia of strabismus is caused by the ocular deviation. Three arguments have been relied on by the upholders of this theory:

1. That with no abnormality of the fundus or field, there is defective vision of the macula;

2. That a visual defect of like character is rarely found without squint; and,

3. That the amblyopic squinting eye improves in vision after tenotomy, disproving the congenital origin of the amblyopia.

Concerning the first point, Dr. Wadsworth finds that the vision of 57 cases of convergent strabismus, taken from his note-books, show an acuity of at least from $\frac{14}{XX}$ to $\frac{14}{XXX}$ in the squinting eye, a result considered not below what commonly happens in non-squinting eyes. As to the second point, 15 cases of amblyopia are adduced existing in non-squinting eyes, and without abnormality of appearance. Referring to the third argument, a faulty previous examination is believed to explain the supposed improvement after tenotomy: "When vision has been exhaustively tested before tenotomy, no real improvement is found after it." There is one important fact that might have been adduced by Dr. Wadsworth in disproof of the commonly accepted theory that amblyopia follows disuse, and that is the very common one that

no amblyopia results from even long-continued disuse in cataract. The reviewer removed the lenses in a case of congenital cataract of sixty years' standing, with an immediate resultant perfection of vision as to acuity, colors, and refraction, where before was only perception of difference between day and night. It is true that there is this possibility of difference between cataract and strabismus, if the matter be looked at from the standpoint of the accepted theory of *amblyopia ex anopsia*, and that is, that in cataract the mind seeks to preserve the possibility of vision, whilst in the other case it seeks to neglect and quench the function. The latter idea would appear to some too volatile, while to others it would seem a support capable of bearing much weight.

A Contribution to the Doctrine of Retinal Glioma.

Freitel gives a very minute description (*Archiv f. Ophthal.*, xxxii. 1), clinical and microscopic, of a case of retinal glioma, from which it appears at least to be improbable that the glioma cells spread in this particular case from the primary tumor by way of the perivascular lymph-sheaths to the small disseminated metastatic patches in the nerve-fibre layer. Freitel thinks that the spontaneous power of locomotion of the tumor cells plays a very unimportant part in the heteroplastic dissemination of neoplasms in the interior of the eye. On the other hand, he thinks that the mode of origin of the metastases in the vitreous which are so often met with, may be more readily explained by assuming that the glioma was developed in intrauterine life, when the vitreous was still vascular, and that the fœtal vessels of the vitreous form the paths by which the glioma cells entered the vitreous. In the case presented by Freitel, the growth was probably at birth smaller in the right eye than in the left eye, and grew very slowly.

OTOLOGY.

UNDER THE CHARGE OF

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Defective Hearing in Railroad Operatives, in Relation to the Safety of the Travelling Public.

Dr. Lichtenberg, of Budapesth (*Congress of Naturalists*, Berlin, 1886), has endeavored to show the importance of good hearing in railroad operatives, and also to demonstrate that locomotive engineers and firemen are liable to various ear-diseases in consequence of their exposing employment. He speaks of the paucity, and unimportance of optical, in comparison to acoustic signals (in Germany?). The writer examined 250 railway operatives and found 92—*i. e.*, 36.8 per cent.—affected with aural diseases. 32 cases were catarrhal in form, 3 were of labyrinthine disease, and in 36 instances the

disease had located in the external auditory canal. He then alluded to the statistics of railway accidents and claimed that, in view of the importance of the acoustic signals and the frequency of their occurrence, and also in view of the frequency of aural diseases in the operatives, railway accidents occur very probably as a consequence of defective hearing in the railway employés.

Epileptiform Symptoms from Disease of the Ear.

Dr. Trautmann, of Berlin (*Congress of Naturalists*, Berlin, 1886), has related a case of exudative inflammation in the middle ear, in a girl, three years old, in whom there also ensued, as a consequence, epileptiform manifestations followed by peculiar paroxysms of another kind. The latter consisted in the falling of her head on her breast, unconsciousness for about one minute, then a deep inspiration and again consciousness. Several months later, Dr. Trautmann discovered unsteadiness of gait and uncertainty of speech, but no other motor or sensory disturbances. Both membranæ were retracted and in the left tympanic cavity there was a copious exudation. Paracentesis was performed and was followed by irrigation through the catheter. Shortly after the operation one of the above named attacks occurred, but after that they ceased to appear. It is held that the exudation was the cause of the epileptiform symptoms in this case. The writer expresses the opinion that in such cases of exudation in the middle ear, which occur with violent symptoms, and in which death may ensue in consequence of meningitis, infectious elements underlie the disease. He further claims that such cases occur often simultaneously in several members of a family, and at a time when nasopharyngeal catarrh is prevalent. The treatment in such cases consists in a prompt paracentesis of the membrana tympani and evacuation of the exudation from the drum-cavity.

The Action of Pilocarpine upon the Mucous Membrane of the Tympanic Cavity.

W. Kosegarten, of Kiel (*Archiv f. Ohrenh.*, Bd. 24, 1886), has found, contrary to the experience of Politzer, that treatment by pilocarpine is useful in cases of chronic dry catarrh of the middle ear, complicated by affections of the labyrinth. Good results cannot be accomplished by a few injections, but rather, if success in these chronic processes is to be obtained, a continued repetition of the injections must be maintained for at least six weeks. The best results have been obtained when the treatment has been carried out for three months. The rule has been to make a daily injection of, on the average, one centigramme of pilocarpine. In those cases in which the treatment extended over three months, the injections were omitted every seventh day. In cases presenting a transparent membrana tympani, and also in one instance of large perforation of the membrana, in which there had been a chronic purulent process, there was visible an intense congestion of the mucous membrane of the drum-cavity and of the membrana after each injection of pilocarpine, and sometimes a secretion was observed to take place in the middle ear. Upon these occurrences the author based his suppositions, that there occurs gradually in this treatment a loosening of the stiff tissues, together with a moistening and softening of the adhesions, and thus the rigid con-

ducting apparatus of the ear is made more readily vibratile again. It is claimed that even in cases of retained exudation absorption may occur, as was very evident in one case in which a previously very white and opaque membrana become normal in color and transparency during the treatment.

The Possibility of Recognizing by the form of the Skull Certain Topographical Features of Importance in the Temporal Bone.

Dr. Otto Koerner, of Frankfort-on-the-Main (*Archiv f. Ohrenh.*, 1886, Bd. 24, S. 67 and 68), maintains, by reason of his examinations of sixty skulls, that it is possible to locate, from observation of the external configuration of the skull, certain important points in its internal structure, especially the position of the middle fossa of the skull and sigmoid sulcus. The "index of the skull" is expressed by a quotient obtained by dividing the distance between the bridge of the nose and the most prominent point of the occiput by the distance between the parietal protuberances. This index varies from 1.55 centimetres in dolichocephalic crania to 1.07 centimetres in the brachycephalic. From tables presented, it appears that the floor of the middle fossa of the skull in the dolichocephalic lies higher above the external porus acusticus and the spina supra meatum than in the brachy-cephalic skulls.

Respecting the transverse sinus, it is shown that it, on the average, extends further outward and forward into the mastoid process in the brachy-cephalic than in the dolichocephalic skull. Independently of the form of the skull, this sinus lies further outward, on the average, on the right than on the left side. The sinus wall was of equal thickness on each side in ten per cent. of the cases, and thinner on the right side in seventy-seven per cent., and thinner on the left side in thirteen per cent.

The practical application of these facts, so far as concerns the operation for opening the mastoid, requires that the smaller the "cranial index" is, the further forward the opening should be made in the mastoid. In adult skulls, with a cranial index of 1.3 centimetres and under, it will be necessary, when possible, to operate in front of the line of attachment of the auricle, especially when the right antrum must be reached. In infants and little children, as is well known, a dangerous position of the transverse sinus does not occur.

The Question of Trephining the Mastoid Process.

After an elaborate paper on the "Diagnosis and Treatment of Acute and Chronic Purulent Inflammation of the Middle Ear-tract, and their Complications," based on 2366 cases selected from over 20,000 cases seen in private and hospital practice, Dr. Samuel Sexton, of New York, considers as follows the question of trephining the mastoid (*Transactions of the American Otological Society*, July 20, 1886).

For purposes of drainage of the middle-ear tract, he favors keeping open the outlet through the tympanum into the canal rather than through the cortex of the mastoid. He further holds that there can be no necessity for this latter operation, so long as relief is obtained by evacuation of purulent matter from the mastoid region through the more natural channel of the tympanum.

"The lower mastoid cellules, when the seat of purulent inflammation, discharge into the antrum when the passage is unobstructed, otherwise through

the posterior wall of the external auditory canal, or the cortex of the mastoid process." From his observation, Dr. Sexton believes that perforative caries takes place in the former quite as often as in the latter situation. "In external periostitis the posterior wall of the canal is perhaps more frequently affected than the cortex of the mastoid process." Were there any indications to guide the surgeon in the detection of pent-up secretions in the cellules of the mastoid before a sinus had announced the fact, Dr. Sexton says he would not hesitate to perforate healthy tissues in order to relieve the patient; but he is unaware of such indications. Where an inflammatory process has caused destruction of the cortex of the mastoid, the sinus should be kept open, and even enlarged, by cutting or chiselling if necessary, remembering in such manipulations that the cranial fossa is only separated from the cellular structure by a more or less thin shell of bone. Special efforts to retain such an opening need not be made after drainage is established through the natural channel—the external auditory canal. Dr. Sexton has never been convinced that "any advantage accrues from any trephining operations which open up only the healthy cellular structure of the mastoid process, nor of the advantages, claimed by some writers, to have taken place on thus carrying a canal from the cortex into the dense hypertrophied mass produced by previous inflammation of the cellules."

Schwartze's indications for trephining the mastoid are considered in order, and rejected by Dr. Sexton as untenable.

"Of the first indication it cannot be admitted that 'œdema, pain, and fever' are pathognomonic of 'acute inflammation of the mastoid cells with retention of pus,' nor can the surgeon rely upon an incision over the mastoid, or in applications alone to relieve inflammation of the cellules, even though the above symptoms were accepted as pathognomonic of this condition."

"As regards the second indication, 'intermittent swelling,' it is of frequent occurrence where drainage from the tympanum is interrupted by the closure of a sinus from the cellules of the mastoid, or by clogging up of a tract of a dissecting tympano-mastoid abscess. It does not 'threaten life.'"

The third indication refers to matter seeking to escape from the cellules into the external auditory canal. Instead of liberating this where it presents, Schwartze proposes to establish an opening through the mastoid process. Here it is urged by him to operate "without hesitation" if "brain-symptoms" are noticed. In other words, if the symptoms are severe, open the mastoid cells for the liberation of purulent matter which is presenting on the superior wall of the external auditory canal." One of Dr. Sexton's cases, Case V., in the article under consideration, presented nearly all the so-called vital indications of Schwartze for opening the mastoid. "All of these symptoms, however, yielded upon the establishment of drainage through a free opening into the posterior superior wall of the canal where pointing was most prominent."

Schwartze's vital indication is based on "symptoms of brain-irritation" in chronic suppuration. "This is tantamount," in Dr. Sexton's opinion, "to recommending the trephining operation on the mastoid process for threatened pachymeningitis." Where periostitis interna is suspected of having reached the cellules, it has been Dr. Sexton's experience that drainage of the middle-ear tract can be best maintained through the natural channel of the tympanum, and adherence to this plan of treatment has never been attended with fatal results in his hands. "Trephining into the mastoid for threatened

pachymeningitis in this manner could only be regarded as warrantable surgery at an early stage, when unfortunately no sure pathognomonic symptoms are recognizable." The expressions "threaten life," "brain symptoms," "symptoms of cerebral irritation," and the like, are regarded as too frequently used in this connection, as untenable assumptions, and misleading, and, when accepted too confidently, as "tending to increase the importance of misconceived indications, rather than the establishment of sound surgical principles."

Recently Described Anatomy of the Ear.

Prof. Gruber, of Vienna (*Congress of Naturalists*, Berlin, September, 1886), has made some discoveries in the anatomy of the region of the round window. He shows that the prevailing view that the labyrinth has but two communications with the tympanic cavity, viz., by means of the round and the oval windows, is not correct. He then demonstrates that the vestibule and the upper passage in the cochlea have a further means of communication with the floor of the tympanic cavity, by means of a chink, which can be found in the niche of the round window. In fresh preparations this chink is filled by the beginning of the ductus cochlearis, which is covered below by the membrane lining the niche of the round window. A fine bristle can, in a normal specimen, be passed with ease from the niche of the round window into the vestibule, where it can be plainly seen after the removal of the stirrup bone from the oval window. The importance of this fact in its physiological, pathological, and therapeutic bearing, is dwelt upon, and it is claimed that, in a clinical sense, the niche of the round window should receive the greatest consideration.

Primary Disease of the Cochlea Ending in Necrosis.

Dr. Trautmann, of Berlin (*Congress of Naturalists*, Berlin, September, 1886), has described a case of the above nature, the only analogue of which he has found described in Schwartze's book.[1] The patient, a man forty-five years old, was attacked, apparently, by violent meningitic symptoms. In six weeks a perforation of the membrana tympani occurred, granulations formed in the auditory canal, and, finally, the necrotic cochlea was thrown out. The malady ended in recovery, excepting that the face remained paralyzed, and the deafness was absolute.

Affections of the Labyrinth from Cerebro-spinal Meningitis.

Dr. Steinbrügge, of Giessen (*Congress of Naturalists*, Berlin, September, 1886), gave an account of two cases of deafness due to cerebro-spinal meningitis, occurring in his own practice. One of these occurred suddenly; the other, more insidiously. The intra-labyrinthine structures are destroyed in this disease in a peculiar way, according to this observer. He claims that in this destructive process there may be distinguished two stages, viz., first the purulent inflammation, and then the necrotic process. The latter is the direct result of the action of the blood-poison upon the small vessels in the periosteum of the semicircular canals. The occurrence of stasis and thrombosis in these vessels is the cause of destruction of the periosteum and the membranous labyrinth-structures fastened to it. The necrosis, however, is not the result of the purulent inflammatory process, but is a primary process, and

[1] Lehrbuch der Chirurgischen Krankheiten des Ohres, p. 376.

thus are explained the early occurrence and irremediable persistence of deafness in many cases of cerebro-spinal meningitis.

Destruction of tissues by pus is chiefly accomplished mechanically, as soon as the latter has accumulated in considerable quantity. For example, it is shown that small masses of pus in the neighborhood of the facial nerve, and among its fibres, can occur without producing symptoms of paralysis; while larger quantities of pus, by pushing apart the fibres of the acoustic nerve seem to destroy it, as shown by one of Steinbrügge's cases. The new formations of connective tissue must be regarded as a more advanced stage of labyrinth disease.

Attention is called to the peculiar state of the temperature in cases of sporadic cerebro-spinal meningitis. Notwithstanding the purulent inflammation of the meninges, and the considerable labyrinthine destructions, the temperature may be only temporarily elevated, and then, for long intervals, entirely normal, when either recovery may take place, or a relapse with fatal issue may ensue.

In the discussion which followed, Dr. Barth, of Berlin, called attention to the fact that in meningitis consequent upon purulent otitis, the temperature may be normal or "subnormal," for one or two weeks before death, then suddenly, perhaps, at the moment of death, it rises. Therefore, if with this low temperature, the other symptoms do not improve, the prognosis must be very guarded, perhaps unfavorable. The question whether this phenomenon is due to irritation of a temperature centre, or to other causes, remains yet an open one. Schwarze, of Halle, stated that meningitis from otitis rarely proves fatal, without a temperature in excess of 38° C. (100.1° F.)—*Archiv f. Ohrenh.*, Bd. 24, S. 73, 1886.

Pathology of Otitis Interna.

Habermann, having made a post-mortem examination of the right temporal bone of a boy who died of cerebro-spinal meningitis, gives the following result of his investigation (*Zeitschrift f. Heilkunde*, Bd. 7, Prag, 1886, and *Archiv f. Ohrenheilk.*, Bd. 24, Nov. 1886). The membrana tympani was gray, dull, and flattened. The jugular fossa was deep, containing a blood-clot, to which there was attached a pale brown thrombus, 2.5 cm. long, which had originated in the inferior petrosal sinus. In the orifice of the aquæductus cochleæ, there was seen a plug of thick yellow pus, which extended further into the aqueduct. The acoustic nerve was pale, and the greater petrosal nerve was highly anæmic. The mucous membrane over the ossicles was somewhat thickened and pale. The floor of the tympanic cavity was very thin. The microscopic examination showed that the acoustic nerve in the inner auditory canal was surrounded by pus, and infiltrated with inflammatory products. Granulation tissue was discovered in the coarser trabeculæ of the endoneurium, and a similar, though less intense condition, was found in connection with the facial nerve. The fibres of the dura mater in the inner auditory canal were found infiltrated by inflammatory products, and the bone from this point was extensively softened, containing sinuses, between which were osteoblasts. The thin plate of bone which separates the vestibule from the internal auditory meatus was wanting, its place being occupied by infiltrated periosteum. The entire cavity of the cochlea was filled with

granulation tissue, which at some points had assumed the appearance and character of connective tissue, excepting the modiolus with the canalis ganglionaris, a part of the partition between the upper and middle passage, and some traces of the lamina spiralis, which were still present, but all the rest of the cochlear contents had been destroyed by suppuration. The aquæductus cochleæ toward the cranial cavity was filled with pus; toward the vestibular canal it was occupied by granulation tissue. The vestibule and the semicircular canals were affected like the cochlea, the circular ligament about the oval window was partly destroyed by granulation tissue, and the membrane of the round window was thickened. The changes in the middle ear were only slight.

DISEASES OF THE LARYNX AND CONTIGUOUS STRUCTURES.

UNDER THE CHARGE OF

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The Journal of Laryngology and Rhinology.

English-reading physicians will heartily welcome a journal which, under the direction of Dr. Morell Mackenzie, aims to give, in their vernacular, succinct but sufficiently full abstracts of whatever is worth knowing in current laryngological literature. Dr. R. Norris Wolfenden is associated in the editorial management, and the list of collaborators includes a number of well-known names, America being ably represented by Dr. J. N. Mackenzie, of Baltimore. The first number is a good one, and the journal will have the cordial wishes of the profession for its success.

The Laryngitis of Typhoid Fever.

Dr. Paul Koch, of Luxembourg (*Contribution a l'etude du laryngo-typhus*), sums up the result of his studies and personal observation as follows:

1. There is a true laryngo-typhus. It always coincides with the acute period of the general malady.

2. If the symptoms of laryngeal stenosis become manifest during the period of reconvalescence from typhoid fever, they are the expression of the perichondritis which in general is manifested in acute maladies of long duration.

3. Operation is indicated as soon as the symptoms of laryngeal stenosis become disquieting.

4. Tracheotomy should always be performed low down, so as to avoid the cricoid region.

5. It requires patience to abandon these perilaryngites and perichondrites to their natural course, which is very long, without wishing to hasten definitive recovery.

6. If, after definitive recovery, the patient cannot dispense with the canula, there is plenty of time to employ mechanical treatment by the two routes open; and, should this not succeed, to practise a resection of a portion of the larynx.

The same author reports a case of laryngeal stricture consecutive to typhoid fever, cured nine years later by tracheotomy and incandescent destruction of an interfering fold of laryngeal mucous membrane.

Submucous Injection of Lactic Acid in Laryngeal Tuberculosis.

Dr. George W. Major, of Montreal (*Canada Medical and Surgical Journal*, Dec. 1886), reports his favorable experience with this method of treatment, originated by Hering, of Warsaw, and subsequently adopted by Krause, of Berlin, who first introduced the superficial application of lactic acid into the therapeutics of tuberculosis of the larynx. The instrument employed is on the principle of the hypodermatic syringe, the needle being of proper length and curve to permit of ready manipulation. The strength of the solution employed varies from twenty to eighty per cent., the quantity injected being from five to ten minims. Should a slough form at the point of puncture, active treatment is to be suspended, but recourse may be had meanwhile to spray of a weaker solution. On separating, the slough leaves a healthy granulating surface, which completely heals in a few days. The method is especially efficacious in the early stages of the disease, that of submucous infiltration, characterized by the pyriform tumefaction of the aryteno-epiglottidean folds.

Ecchondroses and Exostoses of the Larynx.

M. Henry Bertoye (Lyons), in a reprint from the *Annales des mal. de l'oreille et du lar.*, collates recorded cases and adds a personal observation. His patient was a man, forty-two years of age, who died of pulmonary complications seven days after tracheotomy. The tumor, which occupied nearly the entire right side of the internal face of the cricoid cartilage, was hemispherical in shape, and histologically resembled hyaline cartilage undergoing ossific change.

Peroxide of Hydrogen in Whooping-cough.

Dr. B. W. Richardson (*Asclepiad*, No. 13) has treated nine cases of whooping-cough, six males and three females, with peroxide of hydrogen exclusively; giving a fluiddrachm of the ten volume solution five or six times daily. He has not seen equally good results from any other treatment, except change of air. He uses the following formula:

"Hydrogen peroxide (10 vols. strength) . . . ℥vj.
Glycerine, pure . . . . . ℥iv.
Water, distilled . . . . . to ℥iij.—Mix.

To make a solution of three fluidounces, of which let half a fluidounce be taken in a wine-glass of water, as directed."

When there is stridulous spasm, he substitutes ozonic ether, ℥ij, for the solution of the peroxide, or adds it to the mixture.

Epileptiform Seizures from Post-nasal Polypus.

To the few instances on record of convulsions apparently epileptic, due to reflex irritation from nasal polypi, is to be added a case reported by Dr. B. W. Richardson, in the *Asclepiad*, No. 13, 1887. A married lady,

aged thirty-four, not at all hysterical, who had been unsuccessfully treated for epilepsy, stated that the cause of the attacks seemed to be in the back of the throat, and to be produced by something that dropped into the larynx, as when one "swallows the wrong way." Nothing abnormal was found in the larynx, but while the mirror was in the throat a large drop of fluid fell from the post-nasal cavity. Examination being thus directed to the nose, a polyp was discovered, and removed entire with forceps. It was a large fluid gelatinous mass, the size of a large walnut. When gently pressed, drops of gelatinous fluid exuded. For eight years there has been no recurrence of the growth, or of the epileptiform seizures.

Local Treatment of Acute Suppuration in the Maxillary Sinus.

Prof. Stoerk, of Vienna (*Wien. med. Woch.*, No. 43, 1886), recommends the use of a syringe, with a delicate tubular nozzle, to be introduced into the nasal outlet of the sinus, so that the sinus can be thoroughly syringed; a method which he has found preferable to all others. When the tumefaction of the nasal mucous membrane is too great for this procedure, Stoerk merely attempts to reach the vicinity of the opening with the extremity of the syringe, trusting to the sensations of the patient to indicate the moment in which the stream of liquid enters the sinus, and then makes marks on the instrument to facilitate subsequent manipulations. Medicaments should be applied warm, as a rule, and in weak solution; for example, no stronger than a one or two per cent. solution of silver nitrate.

Stricture of the Œsophagus.

Successful graduated dilatation of a stricture, from deglutition of concentrated lye, in a child two years of age, is reported by Dr. Walker Schell, in the *Indiana Medical Journal.*

Dr. McPhedran, of Toronto (*Med. News*, Feb. 12, 1887, p. 191), performed gastrostomy in a woman, aged forty-one, for malignant stricture of the œsophagus, the patient surviving six months and eighteen days.

Gastrotomy and Digital Extraction of a Foreign Body from the Œsophagus.

Dr. Maurice H. Richardson (*Boston Med. and Surg. Journ.*, Dec. 16, 1886), on August 5, 1886, performed gastrotomy, and, inserting his hand and forearm through the wound, succeeded in withdrawing a plate of false teeth from its lodgement in the œsophagus. Under antiseptic treatment, recovery was complete on the 25th of October, the patient returning to his work as a teamster.

Influence of Ether upon the Muscles of the Larynx.

Drs. Semon and Horsley (*Brit. Med. Journ.*, August and September, 1886) have made an important investigation upon the differential action of ether and of electric currents of various strength upon the abductor and adductor muscles; following the researches of Hooper and of Donaldson, Jr. As the whole subject is reviewed in Prof. Bowditch's paper in the present number of this journal, no more than the simple record is needed in this place.

DERMATOLOGY.

UNDER THE CHARGE OF

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LANOLIN.

LIEBREICH (*Deutsche medicinische Wochenschrift*, No. 28, 1886) directs attention to several important points regarding lanolin. Its keeping qualities, as well as its non-irritating properties, depend upon the thorough elimination of its free fatty acids. In the crude wool-fat these acids are present in the proportion of twenty to thirty per cent. Analyses of the different preparations of lanolin (wool-fat plus a proportion of water) on the market disclose wide differences in this respect; that by one pharmacist being practically free from the fatty acids, while in that of another, doubtless on account of partial elimination of the neutral wool-fat, these acids are found present in greater proportion than occurs in the crude wool-fat; in the others the percentage varies between these two extremes. The following are the actual results: Heiner's, 23.24 per cent.; Merck's, 12.23 per cent.; Riedel's, 11.12 per cent.; Jaffé & Darmstädter's, 0.05–0.5 per cent. In the lately introduced lanolinum anhydricum the following percentage: Heiner's, 33 per cent.; Metcalf & Co.'s (agnine), 26.8 per cent.; Merck's, 17.5 per cent.; Eisner & Mendelsohn's, 16.98 per cent.; Riedel's, 16.65 per cent.; Jaffé & Darmstädter's, 0.5–1 per cent.

In ointments containing considerable powder, and also in those containing chemicals which are apt to undergo change when in intimate contact with water, lanolinum anhydricum is to be preferred as the base; also in those ointments, in the preparation of which heat is required. In other instances the ordinary lanolin may be employed. In general, it may be stated that ointments made with the ordinary lanolin are stiffer than those made with lanolinum anhydricum.

SCHWENINGER (*Charité-Annalen*, xi., Jahrg., 1886) gives his experience with lanolin, having treated about two hundred cases of skin disease at the dermatological clinic of the Charité Hospital in Berlin with this remedy. Where practicable, and where the disease was symmetrical, one side of the body was treated with lanolin ointment and the other side with various fats, glycerine, and vaseline ointments. In all cases, without exception, the results were in favor of lanolin. It is to be especially recommended for the relief of thickened, scaly conditions, roughness of the epidermis, eczema, psoriasis, pityriasis, prurigo, and ichthyosis. Moreover, the lanolin preparations are useful where a penetrating action (as in syphilis) is desirable, and where thickened epidermic layers are to be relieved.

Lichen Ruber.

Cæsar Bœck discusses lichen ruber in Norway (*Monatshefte für prak. Dermatologie*, October, 1886), more especially in Christiania, where, as in Northern Germany, the disease is of infrequent occurrence, the author having encountered only seven cases during a period of eleven years. Both varieties of the disease—the acuminate and the plane—were met with, but more frequently the plane. In two cases the acuminate was combined with the plane, but the former was in no instance found to exist alone. The subjects were all in good circumstances, an observation which has been on more than one occasion noted concerning the etiology of this affection by other reporters of cases. Bœck considers that the so-called lichen ruber (Hebra) and lichen planus (Wilson), constituting respectively the acuminate and plane varieties of the lichen ruber of most authors, are one and the same disease, a view which is in opposition to the opinion of Robinson, of New York, who regards a slightly developed horny layer of the epidermis as characteristic of lichen planus. Bœck finds that this layer, although often variable in its development, is, as a rule, strongly marked, which, he adds, is in accord with clinical observation. All the cases reported were of a mild type, though two had existed thirteen and twenty-six years. The author observes that the disease pursues a variable course in different countries, concerning which point there seems to be no doubt.

Rare Forms of Iodide Eruption.

Janowsky (*Monatshefte für prak. Dermatologie*, October, 1886) gives three cases of rare forms of iodide eruption. The first is that of a man, the subject of syphilis, aged fifty, and is similar to one reported by Morrow, of New York. The face was involved, and the affection was characterized by febrile symptoms, swelling, and an eruption of distended, clear vesicles of variable size. The mucous membrane of the mouth was also invaded. In the course of a few days the eruption became crusted and eczematous in appearance. Iodide of potassium was found in the urine and also in the vesicles. The efflorescence appeared on the second day, after only thirty grains had been taken, and was the second time the patient had suffered from the cutaneous manifestation. The second case was that of a syphilitic woman, the lesions being hemorrhagic, of the form of purpura, and involved the lower extremities. Similar cases are reported by Fox and by Thin. The third case occurred in a syphilitic man, forty-six years of age, the cutaneous lesions resembling erythema nodosum, but lacking the bluish tints. The urine contained iodine. The disease was produced a second time by again using the iodide after the first attack had passed off. The author regards this case as being like those described by Pellizzari a few years ago, and inclines to this observer's view of the specific action of iodine on the vascular system. It has been repeatedly shown that the extent of the eruption bears no relation to the amount of the medicine used.

Ichthyol.

In the *Chicago Medical Journal* for December, 1886, Zeisler reports his experience with ichthyol. Externally, in all forms of eczema it proved use-

ful, the result in all but a few cases being favorable; according to the degree of acuteness, the remedy should be applied in the proportion varying from five to thirty per cent. In sycosis its effects were good in a majority of the cases; it was employed in the form of a ten per cent. ointment, in conjunction with a soap of ichthyol. In acne vulgaris the results were not positive. In acne rosacea its favorable influence was undoubted.

Internally, the remedy was given in about twenty-five cases, in doses varying from three to to fifteen grains thrice daily. In general, as the author states from his limited experience, it may be said that in all cases in which the rheumatic diathesis and dyspeptic ailments may be considered etiological factors ichthyol will have indirectly a favorable influence by removing these conditions. Independently of such predisposing causes, however, it acted well, in the author's experience, in a few cases of acne and acne rosacea in which it was prescribed. Possibly in some instances it may act, as suggested by Unna, by its contracting effects upon the cutaneous capillaries.

PROF. SCHWENINGER (*Charité-Annalen*, xi., Jahrg. 1886) has, since 1883, employed ichthyol, chiefly in from ten to fifty per cent. solutions, in rheumatism, lumbago, neuralgias, gout, and migraine, and finds that in relieving the pains accompanying these diseases it acts better than any other known medicament. It also proved useful in the treatment of open wounds and in gangrenous sores, applied on cloths or lint, and relieved pain about as effectually as the other well-known remedies. In chronic eczema a ten per cent. ointment with oxide of zinc was employed, and in keratoses, where the epidermis had been previously removed by maceration and soap, it was found to cause healing rapidly. Internally, in the form of capsules, containing ten per cent. solutions in ether, alcohol, glycerine, or water, it also proved valuable in various skin diseases, malaria, and East Indian fever.

IMPORTANCE OF THE USE OF THE ABSOLUTE GALVANOMETER IN THE DESTRUCTION OF SUPERFLUOUS HAIR BY ELECTROLYSIS.

In a recent number (November 4, 1886) of the *Boston Medical and Surgical Journal*, PRINCE contributes some practical points to the subject of the removal of hair by electrolysis. The great desideratum is to effect the destruction of the papillæ without the production of scarring. In a certain percentage of cases this untoward result has been recognized by all observers as practically inevitable, and has been considered due to individual peculiarity of the skin. Prince is of the opinion, however, that such a result is more probably caused by the use of too strong a current. The great variability in the strength of the current from the same number of cells, not only in different batteries but under varying conditions in the same battery, is well known, and hence the customary statement to use a certain number of cells is unscientific, and not without its dangers as relates to the matter of scarring. Another gauge usually advised is the occurrence of effervescence about the outlet of the follicles; but this is equally unscientific as this does not always show itself, and moreover the destruction of the papillæ may be effected with less chemical action than implied by effervescence.

All precautions should be taken toward avoiding variability in the current;

for instance, instead of the sponge electrode, with which the current is weaker or stronger according to the degree of compression made, the positive electrode should consist of a metallic plate, covered either with chamois or a layer of absorbent cotton and fastened to the forearm. This being the case, there should, of course, be an arrangement by which the current at the positive side could be broken before the needle is withdrawn. A suitable galvanometer, such as the author describes, permits thorough control of the battery, and the strength of the current may be readily measured. A current of one milliampère, passing two or three seconds, the author finds most satisfactory; it never should exceed two milliampères. If the papilla is not destroyed in the time stated, the fault lies with the introduction of the needle—the failure to strike the papilla. During the sitting constant attention should be given to the galvanometer, in order that the current may be kept at a uniform strength.

The Treatment of Hypertrichosis.

Karewski, in a paper (*Deutsche medicinische Wochenschrift*, No. 34, 1886) on this subject, discusses the now well-known method by electrolysis and a new method by the galvano-cautery. The author's experience with electrolysis has been such as to confirm its practicability and efficacy. An interesting point is his statement that there is practically no difference in the results, whether the needle is attached to the negative or to the positive pole, as at both poles disintegration will take place. If, however, the needle is attached to the positive electrode, it is necessary that it should be one of platinum or platino-iridium; with a steel needle oxidization occurs, the oxide of iron is left in the follicle, and a permanent pigment-speck remains. In regard to the method by galvano-cautery, the author speaks equally favorably. A suitable handle is required, to which is attached a properly constructed needle. This latter consists of two platinum wires which are welded together at one end and ground to form a needle as fine in calibre as that commonly employed in electrolysis. The two free ends are attached to the handle, one connecting with the positive electrode and the other with the negative. When the battery is put in action the needle becomes heated to a white heat, and is then ready for the operation. (In the original paper a descriptive cut is given of both the needle and handle.—Eds.) The procedure is, in its further steps, somewhat similar to that of electrolysis.

The author sums up his experience with both methods as follows: 1. Both the galvano-cautery and electrolysis are adapted for the permanent removal of superfluous hair. 2. Both accomplish the purpose, with few exceptions, without perceptible scarring. 3. The galvano-cautery is more rapid and less painful, but the operation is, for the days immediately following it, more disfiguring.

The Anatomy of Keloid in its Early Stage.

An opportunity was offered Crocker (*British Medical Journal*, September 18, 1886) of studying the anatomy of a keloidal formation, arising from a scar, of less than a month's growth. Histologically the tumor was found, even at this early stage, to differ but slightly from similar growths at a more advanced period, except that there still remained an abundance of cells and

nuclei, and as yet very few, if any, of the bloodvessels had been obliterated and changed into fibrous bands, as is known to happen as the tumor develops, especially in the central portions. The author considers the division of keloid into two classes—true and false—to be without anatomical or clinical foundation. An interesting and practical point evolved, confirmatory of Warren's observations, is that the bloodvessels are affected far beyond the tumor. The value of this observation is obvious, as in those cases in which interference is deemed advisable, it is essential, if a recurrence is to be avoided, to cut wide of the growth in order to get beyond the diseased vessels. The tumor, the investigation of which formed the basis of this paper, was treated in this manner, and four months later there had been no sign of a return.

A Contribution to the Clinical Study of Scleroderma.

The notes of two cases of this disease are given (*Journal of Cutaneous and Venereal Diseases*, November, 1886) by Graham. In one, a woman, aged forty-seven, the affection, which involved the whole surface, ran its course in ten months, ending in complete recovery. There was at no time œdema, and there was but slight pigmentation, and this limited to the back of the neck and the upper lip. In the second case, a male, aged thirty-nine, the disease involved the trunk and limbs with considerable pigmentation and, in the beginning, œdema. Up to the time of report it had shown no marked change for the better. In both of these cases there was a family history of rheumatism, although in neither had the patient suffered from the ordinary phenomena of this disease. From a study, symptomatically and pathologically, of the disease, based upon cases afforded by the literature and his own experience, the author is led to look upon it as a manifestation of the rheumatic diathesis, and, in view of this conclusion, advises the employment of anti-rheumatic remedies, such as potassium iodide, salicylate of sodium, etc., and, externally, baths, friction with oil, and the like. The author shares the view of several other observers in stating that there are two forms of the disease—acute and chronic; his first case representing the acute type and the second case the chronic form. In regard to the relationship of scleroderma to morphœa, Graham inclines to the belief that they are closely allied, but for the present it is inadvisable to class them as one disease.

A Case of Exfoliative Dermatitis (Pityriasis Rubra?) with Bullous Lesions.

In the *Journal of Cutaneous and Venereal Diseases* for November, 1886, Hardaway reports a case in the course of which to the ordinary symptoms of pityriasis rubra was added, for a period of a week or ten days, the presence of bullous lesions. These appeared in crops of a dozen or less, and were scattered irregularly over the general surface. Each crop was preceded by a chill, with subsequent slight elevation of the temperature; but there was no regularity in their appearance. This anomalous formation then disappeared, and subsequently, at least so long as the case was under observation, the usual symptoms of pityriasis rubra were noted.

Two Cases of Lupus Treated successfully with Iodoform.

Tyrrell reports (*British Medical Journal*, October 30, 1886) briefly two cases of lupus vulgarus involving the nose and upper lip, in which the local treatment consisted solely of the application of iodoform in the form of an ointment (a drachm of iodoform to the ounce of vaseline). Cod-liver oil was prescribed in both cases. The parts soon assumed a healthy appearance, healing gradually but uninterruptedly; in one case a cure resulting in six months, and in the other in four to five months.

Pastes in Cutaneous Therapeutics.

According to Martin's experience (*Deutsche medicinische Wochenschrift*, December 30, 1886), better results follow the treatment of inflammatory skin diseases, especially those of an eczematous type, by means of pastes than are to be secured by other methods. What is commonly known as Lassar's paste—Ac. salicylici, gr. x; pulv. zinci oxidi, pulv. amyli, āā ʒij; vaselin, ʒij—was employed in the author's cases. It may be advantageously used in all forms of eczema. Where the parts affected permitted—as, for example, about the hands, arms, legs, etc.—the skin, after a thorough soap and water washing, is coated over with a thick layer of the paste, this covered with a thin film of clean cotton, and then a bandage of gauze applied. This dressing may remain on for several days, and in some instances even a week or longer. Rarely more than the repetition of three such dressings is necessary for a cure. When the eczema is upon the face, for obvious reasons the above method of application is impracticable, and the paste is, therefore, simply smeared on at frequent intervals. About the angles of the ears and nose, after applying the paste, a small thin film of cotton may be stuck on over it with better effect.

Mycosis Fungoïdes.

Köbner presents (*Deutsche medicinische Wochenschrift*, Nos. 39 and 40, 1886) the results of a careful study of this curious affection, based upon clinical observation and an analysis of the literature of the subject. Two cases are reported in full; in one of which the type was mild, and under increasing doses of arsenic recovery took place (two and a half years later there had been no reappearance of the disease); in the other case, the disease followed the usual course, a fatal result ensuing a few years after its first appearance.

Clinically there seem to be two varieties of the disease. In one, which the author's first case represents, the disease is usually more localized, being confined to several regions; the tumors are not so liable to sudden appearance and disappearance, are of slow growth, and there is no disturbance of the general health. There is always, however, the usual premonitory stage of red, eczema-like patches or superficial infiltration. This variety is apparently susceptible of relief by the arsenical treatment.

The second variety is more frequently observed. Its course may be divided into four stages. The first stage shows only erythematous patches or scattered eczematous lesions, and occasionally urticaria-like eruption. This may last from one to two years (and rarely as happened in the author's second

case, entirely disappear), when the second stage, which may appropriately be called the period of (flat) infiltration, begins. These lesions which are flat or semi-globular, bright or vermilion-red, exceedingly itchy, soft to tolerably tough, covered with a tense and shiny epiderm, may disappear entirely in one place and a new and similar growth appear in other regions, going through the same stages. In some of these growths the centre only is absorbed and there remains a peripheral desquamating wall. After some months, by additional growth or confluence of such infiltrations, or from an eczematous basis, or less frequently from an area of skin previously involved and healed, or from apparently sound skin, appear the peculiar, knobby, polymorphous tumors, ragged or furrowed, dark red, in appearance not unlike a tomato or mushroom. In this, the third stage, the growths may in a short time, individually or through confluence, become the size of an orange or larger, and rarely a tumor may become pedunculated. Itching persists, and there is a constant serous discharge, which, with the exfoliating epiderm, gives rise to crusts. Even in this stage individual tumors may disappear by absorption without leaving a trace. At this time also superficial ulceration of the growths is noted, from which oozes a considerable amount of serum and thin pus, which rapidly undergoes decomposition, and, in spite of antiseptic applications, gives rise to a fetid odor. Only after months does the general health begin to suffer, exhaustion being gradually induced through loss of sleep in consequence of the intense itching, and from the constant serous and purulent discharge. In this way the disease gradually goes into the fourth stage—the stage of cachexia, in which, in addition to superficial ulceration, the growths may be the seat of deep-seated, crateriform ulcers; in fact, there may be a complete slough of individual tumors, the destructive process extending, in some instances, through to the periosteum. In some cases the growths may appear on the mucous membranes. Wasting diarrhœa, frequent chills, with increased temperature, which are often met with in this stage and hasten the end, may be looked upon usually as symptoms of septicæmia. The usual complications which lead to a rapidly fatal issue are, above all, pneumonia and pleuritis, with rapid effusion; less frequently nephritis and uræmia. According to published cases, an unquestionable example of metastasis to internal organs has not been observed.

Briefly stated, there was found, microscopically, infiltration of the corium, made up of large, mainly round, and to a less extent ovoid, single-nucleated cells lying between the greatly separated connective-tissue fibres; the cell infiltration, in the middle of the markedly developed growths, was so great as essentially to destroy all traces of these fibrillæ. Between the cell masses were seen scattered large cells containing several nuclei, variously shaped "Mastzellen," and, especially near the lower border of the infiltration, remarkably large spindle-shaped cells, filled with finely and coarsely granular protoplasm. In recent growths could be seen the cell accumulations beginning around the subpapillary, superficial vessels of the corium, and extending upward along the papillary branches to the corneous layer, which is finally broken through and ulceration results. In the rete were seen many wandering cells, and here, as likewise in the papillæ, branching brownish pigment cells. The bacterial investigation, carefully made, gave negative results.

The author contends, both from the anatomical data and the clinical course

of the disease, and especially from the fact that the tumors may undergo spontaneous involution, that the view which classes it as a sarcoma or related disease is erroneous; and states that if the affection in its entire course be studied clinically and histologically, this becomes evident. His own view is that it is a typical chronic infective disease, and that Bazin's view of its analogy to leprosy has much evidence in its favor.

Impetigo Contagiosa.

A paper on this disease is contributed (*Daniel's Texas Medical Journal*, August, 1886) by Beall. His experience embraces twenty-four cases. Clinically the cases illustrated the disease as ordinarily described. A peculiarity, in a few of the cases, in the separation of some of the crusts from the underlying skin was noticed—detachment beginning at the centre and progressing centrifugally. When this occurred the maculation showing the site of the lesion, and which persists for some time afterward, displayed different degrees of intensity in concentric rings—the darkest at the periphery, and the lightest at the centre. This peculiarity, when present, the writer thinks may be considered pathognomonic. At the time of observation of the first group of cases, smallpox was prevalent, and hence vaccination largely practised, and in these cases there may have been some relationship between that operation and the contagious impetigo; in the group of cases recently observed, however, no relationship was demonstrable. In examination of the crust a peculiar microörganism was discovered, to which, in the author's judgment, the disease is to be attributed. The same organism was subsequently found also in the fluid of a matured vesicle. The crust was treated with a three per cent. solution of pure caustic potash, then stained with eosin, and mounted in glycerine. The examinations were made with a one-fifth Gundlach objective, D eye-piece, and amplifying tube. Differentiation was facilitated by staining. In the microscopic field could be seen epithelium, scattered oil globules, and crystals of margarine, and numerous minute, round, and oval bodies. These last, the microörganisms, were constant, and "in all probability the direct factor in the etiology of the disease." These organisms, under white light, were colorless, highly refractive, spheroidal and ovoidal, and $\frac{1}{8000}$ to $\frac{1}{5000}$ of an inch in diameter, and scattered through the field singly or in pairs.

MIDWIFERY AND GYNECOLOGY.

UNDER THE CHARGE OF

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The Desirability of the Early Performance of Laparotomy in Cases of Abdominal Pregnancy.

Lusk (*Brit. Med. Journal*, December 4, 1886) first narrates his case, which is briefly as follows:

Mrs. B., æt. thirty-five, menstruated regularly until the end of October, 1883. On Oct. 24th of the same year, and also on Nov. 6th and 7th, she had

severe attacks of pain referred to the right side, but radiating over the abdomen. Pregnancy was diagnosticated, and confinement expected in July, 1884. On July 17th there was some vaginal discharge, a few pains, but no other signs of labor. Doubt was now cast on the supposition of pregnancy, one consultant alleging it was cystofibroma of the posterior uterine wall. The tumor diminished after the death of the fœtus, and was considered an abdominal pregnancy by Drs. Fordyce Barker, Thomas, and Lusk, who were now consulted. Operation was advised by them should dangerous symptoms arise, but was put off on other advice, until her strength was reduced by diarrhœa and septic mischief. In March, 1886, the condition was serious: pulse rapid, temperature 104° F., great emaciation and anæmia. Operation was performed on March 19th, as follows: After a median incision below the navel, the sac, non-adherent to the abdominal walls, was opened. Colorless water and fetid gas escaped, and then a macerated shrunken fœtus was removed, but no trace of placenta or cord could be found. The edges of the sac were stitched to the abdominal wound, free stimulation employed, but the patient sank forty hours afterward. On post-mortem it seemed as if the ovum had developed in the fimbriated end of the Fallopian tube.

Lusk adds four tables of cases as an aid to settling the point of early operation or not. In Table I. there are 29 cases of abdominal pregnancy, ending in fistulous openings; of these 9 died, and many of the remainder can hardly be dignified with the term "recovery." In Table II. 8 cases are given where death occurred before fistulæ formed. In Tables III. and IV. there are collected 52 cases of laparotomy (secondary) for abdominal pregnancy, with a mortality of 15, and recovery of 37. This does not give a fair picture of what might have been done, as in only 3 of the 15 could the operation be charged with the fatal result. In Table V. 11 cases of primary operation are recorded, with two maternal recoveries, and two children saved. Lusk is cautious in his conclusions, but recommends primary laparotomy and improvement in the technique of secondary laparotomy in the direction of earlier operation and entire removal of the sac.

The following few cases illustrate the moot question of the treatment of early tubal pregnancy:

Lawson Tait (*Brit. Gynec. Journ.*, November, 1886) showed a preparation of tubal pregnancy removed after rupture of the sac. The patient was so collapsed that operation had to be delayed for some hours until the use of stimulants and hot-water bottles brought on reaction. The left tube was then removed by laparotomy, and a large quantity of blood removed. Recovery was uninterrupted.

Hart (*Brit. Med. Journ.*, December 4, 1886) records a similar successful case.

Mundé (*Am. Journ. of Obstetrics*, January, 1887) showed at the New York Obstetrical Society a specimen of tubal pregnancy. The patient was admitted into hospital with the history of sudden violent pains, and collapse occurring the day before. The pulse was 120, respiration 24, and abdomen tympanitic. From this, and the fact that the patient had menstruated six weeks before, rupture of a Fallopian tube and pregnancy were diagnosticated. The usual palliative treatment was employed, but the patient suddenly collapsed in a few days. On post-mortem, a tubal gestation firmly adherent in Douglas's pouch, was discovered with a slight rent on its posterior surface.

The pathologist expressed his opinion that it would have been impossible to arrest the hemorrhages by laparotomy. In the discussion on this specimen, Dr. Janvrin related a case where, after recovery from partial rupture, he applied galvanism to destroy the fœtus. The morning after the third séance, nine days after the first hemorrhage, the patient was seized with tremendous bleeding, and died in forty hours. On post-mortem, a slight rupture, involving a small artery, was found, as well as a second and more complete rupture at the same point.

Case of Extra-uterine Gestation Arrested by Electricity.

Dr. Aveling's case (*Brit. Med. Journ.*, December 4, 1886) had the ordinary symptoms and signs of extra-uterine gestation, viz., suppression of menstruation, occasional severe colicky pains, expulsion of portions of decidua, and, finally, at the third and fourth months, a retro-uterine tumor steadily increasing in size. Dr. Aveling applied the interrupted current, the negative pole over the swelling felt through the vaginal roof, the positive over the abdominal wall. Each application lasted ten minutes, and after four such, made on consecutive days, great improvement took place, the tumor becoming decidedly smaller and pain lessening. In two months the swelling, originally the size of a man's fist, could be felt only as a small elongate body.

Extra-uterine Gestation Treated by Galvanic Puncture.

Dr. Petch (*Brit. Med. Journ.*, December 4, 1886) used the galvanic current in his case passing insulated needles into the tumor. A Leclanché battery was used and the current of thirty cells allowed to pass for an hour.

In Dr. Petch's case the gestation had gone on beyond the fifth month as fœtal heart sounds were heard, and fœtal movements felt by the patient. The day after the current was used, the heart sounds were feeble and in three days could not be heard. Twelve months afterward the tumor was the size of a cocoanut, and in three years it had disappeared.

In this case the galvanic current was used "from consideration of its well-known chemical effects in the coagulation and decomposition of albuminous tissues, and its power of splitting up both organic and inorganic substances into various absorbable products."

The following facts should be remembered in connection with the use of electricity in early extrauterine gestation.

1. The placenta may grow after the fœtus is dead. 2. Manipulation of the uterus, such as passing a sound into it, may cause rupture of the sac. 3. The dead fœtus may not be absorbed. 4. Diagnosis is doubtful in some cases.

Case of Forcible Tearing out of the Uterus, and Complete Destruction of the Recto-vaginal Septum; Recovery.

Schmalfuss reports (*Centralbl. für Gynäk.*, No. 46, 1886) an interesting medico-legal case, showing the tolerance of the female pelvic organs to the most violent injury.

M. B., forty years of age, was brought by the police to the Infirmary. The history given was as follows: The patient had been drinking with two workmen, who afterward had connection with her consent. She then felt great

pain in the lower part of the abdomen, and became unconscious. Fourteen hours elapsed before she was attended to medically, when the following was found to be her state:

She was stupid looking, clothes covered with mud and blood, and in some respects looked like a woman who had been confined. The pulse was feeble, easily compressible, but not specially bad; sensorium clear; no fever and no pain, except a burning in the lower part of the abdomen. On local examination, a fleshy lump was noted protruding from the introitus vaginæ; it was covered with clots and mud, and at first sight looked like an expelled placenta. When cleansed, however, it was discovered to be the uterus torn from its attachments, and brought outside the vaginal entrance, so that the os looked to the anterior vaginal wall, and the fundus to the ground. The whole recto-vaginal septum was torn through, and the uterus retained only by the remaining part of the anterior vaginal wall and the left ligaments. At the lateral angles of the uterus one could see parts of the round ligaments, the tubes, and the broad ligaments, and at the fundus and posterior wall false membranes; the ovaries were not in sight, and the bladder and urethra were uninjured. There was no bleeding. The bladder was allowed to remain full, so as to prevent any further prolapse of abdominal contents.

The treatment adopted was as follows: The uterus was severed from its remaining attachments, elastic ligatures being employed. The lacerated portions of the vagina and septum were removed, the cloaca washed out with corrosive sublimate (1: 5000), and plugged with iodoform gauze. The patient recovered, and when examined on the twenty-first day had the following local condition: A deep cloca was present, whose anterior and antero-lateral walls were vaginal, the posterior and postero-lateral being rectal mucous membrane. Bridges of granulation tissue lay between. By two plastic operations the recto-vaginal septum and sphincter ani were restored.

This injury had evidently been caused by the perpetrator passing his hand into the rectum, seizing the uterus, and forcibly dragging it out, the recto-vaginal wall being necessarily torn. The full bladder, fainting of the patient, and the old uterine adhesions, helped to render the injury so far harmless.

Cure of Severe Puerperal Disease by Amputation of the Septic Corpus Uteri.

Schultze, of Jena (*Deutsche med. Woch.*, Nov. 4, 1886), records here a remarkable case where he amputated a bicornuous uterus for retention of the placenta in the pregnant horn and septic infection.

F. S., twenty-one years of age, had, in the seventh month of pregnancy, a dead child born (Sept. 7). The placenta was retained, and the midwife, in her attempts to remove it, tore away the cord. Some time afterward the medical man who was summoned found the cervix of the double uterus so narrow that he was unable to reach the placenta. Expression was of no effect. She was then taken into hospital, and on the following day the same difficulty felt. Hot baths, the constant current, and deep narcosis had no influence on the calibre of the canal, which scarcely admitted a finger.

On the 9th the evening temperature was 39.9° C., and there were rigors, with putrid discharge.

On the 10th examination under deep narcosis was again had recourse to, and a stricture admitting the finger found in the right horn. The left horn was empty. In the right the placenta was found adherent, and a small stinking piece was removed. On the 11th the temperature was 40.1° C., and there were rigors and beginning peritoneal disturbance. Laparotomy was therefore performed on the morning of the 13th (sixth day of puerperium). Schultze had before him three courses, viz., to do a conservative Cæsarean section, removing the placenta only, or if necessary to remove the horn with the placenta; most probably he considered the amputation of both horns would be required. The incision from navel to symphysis was made in the middle line, the uterus turned out with the hand, an elastic ligature applied, the uterus incised, and the stinking placenta removed. The uterine wall was found to be rotten, the putridity extending to 2 mm. below the peritoneal reflexion. As the left horn was also discolored, amputation of both horns was imperative. There was an exudation in the pelvis. The infundibulo-pelvic ligaments (of the ovary) were found so short that a pure Porro's operation could not be carried out. These ligaments, therefore, were tied and divided, the uterus and ovaries brought out, and any part of the broad ligament gaping between the elastic tube and the ligatures stitched with a running catgut suture. It was evidently impossible to treat the pedicle by Schröder's method for fibroids, as pus could be squeezed out of the lymphatics of the stump; it was therefore fastened in the abdominal incision according to Hegar's method, the peritoneum stitched to it below the elastic tube, the surface of the stump seared, and afterward chloride of zinc applied. The temperature soon fell, and on the ninth day the seared portion of the stump was removed with scissors.

Schultze finally lays down the following indications for such interference, viz., the mischief must be in the uterus, and the possibility of septic thrombosis and embolism elsewhere must be excluded. [In a case of pregnancy in the horn of a double uterus which I saw in consultation, the labor came on at the seventh month, the placenta was adherent and removed with difficulty, and only after deep narcosis, owing to marked spasm of the contraction ring. The patient made a bad recovery.]

Ingleby Lectures on Abdominal Surgery.

Mr. Tait records (*Medical Press and Circular*, Nos. 20 and 21, 1886), *inter alia*, a case where he performed abdominal section for puerperal peritonitis. The patient was under Dr. Lycett's care, and had a severe operative labor. On the third day acute peritonitis appeared in the right iliac region, and soon became general. There was great distention on the fifth day, pulse 135, hiccough, and incessant vomiting. Next day, when seen by Mr. Tait, the pulse was uncountable, and bilious vomiting present.

On abdominal section the mischief was found in the right iliac fossa, where the uterus was fixed to the pelvic brim. Bloody purulent fluid was evacuated after the adhesions were broken down: a glass drainage tube was passed deep into the pelvis, and the wound closed. The pulse soon fell, vomiting ceased at once, and the patient recovered.

Acute Peritonitis; Operation and Recovery.

Dr. J. W. Taylor records (*British Medical Journal*, December 18, 1886) a case of abdominal section for general peritonitis caused by rupture of an abscess of the ovary. The patient was attended during labor (September 29, 1886) by Dr. Phillips, and had forceps applied for uterine inertia. On the third day she had pain in the left iliac region, and up till the end of October had intermittent feverish attacks, with pain and tenderness there. On November 11th she was seized with sudden pain and vomiting. Next day her temperature was 104° F., pulse 100. The abdomen was distended and tender, and an ill-defined swelling could be made out behind the uterus on vaginal examination.

Abdominal section was performed on November 14th, when sero-purulent fluid was found in the abdomen and pelvis. The left uterine appendages, intestines, and omentum were matted, but ultimately the Fallopian tube and ovary were isolated and brought up. The ovary was then found to contain an abscess, which had burst by two ulcerated openings. The tube and ovary were, therefore, removed by ligature, the abdomen well washed out with warm water, and a drainage tube inserted. The patient was convalescent November 28th, temperature and pulse being normal.

Fibrous Poylpi Complicating the Puerperium.

In this communication Halliday Croom mentions briefly the previously recorded cases similar to his, and then narrates two observed by him.

Case I. Patient was first seen with retroverted and enlarged uterus; polypus was suspected. After dilatation with tupelo tents, the base of this polypus was felt, but Croom was unable to remove it. When next seen the patient was six months pregnant, and after spontaneous premature labor there was so much hemorrhage that the inside of the uterus was explored, and a polypus about the size of an orange twisted off from the fundus.

Despite intrauterine injection of corrosive sublimate, the patient died from septicæmia on the sixth day.

Case II. was somewhat similar, except that the labor was normal, and the patient recovered. The recorded cases are 21, grouped as follows:

1. Non-gangrenous, in which a healthy tumor was expelled without any artificial aid	5
2. Gangrenous	6
3. Gangrenous or non-gangrenous removed artificially with hand or instrument	10
Total	21

Budin, in his *Obstétrique et Gynécologie* (1886), records a case where labor was so obstructed, but the tumor was not expelled.

Death from Sublimate Poisoning after two Vaginal Injections.

Since 1885 corrosive sublimate has been used in the Prag. Obstetric Klinik, under Prof. Breisky's care, but in renal cases, in those with intestinal troubles,

and in anæmic and badly nourished women uterine injections of it were not employed. For bathing the external genitals and as a vaginal douche, 1:2000 was the strength of the douche, and if repeatedly used it was diluted to 1:4000. Up to August 28th of this year, according to FLEISCHMANN "Tödliche Sublimatvergiftung nach einer zweimaligen Scheidenausspülung." *Centralbl. für Gynäk.*, No. 47, 1886), 1620 cases were so treated with no bad result until the following:

M. C., seventeen, primipara, had been well during pregnancy with no symptoms of kidney affection. On the first day of her labor, August 28th, the vagina was douched with 1:2000 corrosive sublimate before and after a vaginal examination. Prior to this examination a small quantity of bloody slime had passed from the genitals. After the second douche pain was felt in the lower part of the abdomen with vomiting and diarrhœa. Carbolic douche was now employed and some laudanum given for the diarrhœa. The child was born on the 29th, the vagina being douched with carbolic lotion after the expulsion of the placenta, and catgut sutures applied to the perineal and vestibular tears.

The puerperium was briefly as follows:

August 29th (afternoon). Six fluid motions, salivation, scanty urine.

30th. Gums spongy; grayish-white spots below the tongue; throat congested; urine scanty and albuminous, with hyaline and granular casts, kidney and bladder epithelium, and broken-down red blood-corpuscles.

The diarrhœa and scanty urine continued; tympanites began on the 31st and death from coma occurred on September 5th, eight days after the use of the sublimate.

Post-mortem examination showed acute Bright's disease, dysentery, ulcerated stomatitis and pharyngitis, parenchymatous degeneration of the myocardium and liver, pneumonia, acute cystitis, and imperfect involution of the uterus.

Fleischmann discusses this case and comes to the conclusion that corrosive sublimate poisoning had occurred, the sublimate passing into the circulation through small lesions of the mucous membrane at the internal os. He believes with Thorn (*Volkmann's Samml.*, No. 250) that corrosive sublimate should never be used for vaginal or uterine douching, but only for the skin surfaces of the patient and medical man. Carbolic acid should be employed as a substitute in the former instances.

[This case is certainly exceptional. Mischief might have arisen from carbolic acid. It is probable that the sublimate passed by some mischance directly into the circulation. The fatal injections were given by a midwife, and it is not stated if any forcible dilatation was used.]

THE ORIGIN, DIAGNOSIS, AND SURGICAL TREATMENT OF GENITAL TUBERCULOSIS IN WOMEN.

For some time HEGAR (*Die Entstehung, Diagnose, und chirurgische Behandlung der Genitaltuberculose des Weibes*) had in his castration cases met with instances where the Fallopian tubes contained cheesy matter. Mandach, a Swiss practitioner, had, in 1882 and 1883, removed a tubercular kidney and afterward a tubercular Fallopian tube from a patient successfully, while Czerny had also removed a tubercular tube in a case of tubercular peritonitis.

Hegar had considered his cases as adhesive peritonitis with thickened pus in the tubes, and as a condition following pyosalpinx. The first thing that cast doubt on this idea was the occurrence of pulmonary disease afterward in such a patient: and he, therefore, reconsidered all such from a new etiological standpoint.

In the monograph, Hegar considers the subject of genital tuberculosis with special reference to diagnosis, origin, and treatment by laparotomy when pelvic in women.

The subject is so interesting and valuable that we abstract it fully.

Origin. Tuberculosis does not affect the testicle and ovary so frequently as it does the Fallopian tubes or epididymis. The body of the uterus, the vas deferens, and especially the cervix uteri, are rarely attacked: the vagina is less frequently involved than the uterus and tubes. Friedländer observed an isolated tubercular eruption below a shallow ulcer near the os uteri: nowhere else was there a similar affection. As to the frequency of primary genital tuberculosis, Dr. Mosler found eight out of forty-six instances primary; Frerichs, in ninety-six post-mortem examinations of tubercular bodies, found the sexual organs involved fifteen times, in three of these the affection being primary.

In men, genital tuberculosis, secondary or primary, is more common than in women, so far as one can trust statistics.

Hegar then discusses the question of the latency of genital and peritoneal tuberculosis, pointing out that it may run a slow, chronic course, and may spontaneously cure by caseation or suppuration. Cases of cure of peritoneal tuberculosis are not rare, and have been recorded by Wells, Neumann, and others. In men there is greater opportunity for cure than in women; but, although the Fallopian tube may be perforated, or the disease may spread through the ostium abdominale, it may become encapsuled by adhesion to neighboring organs, more especially to the posterior surface of the uterus or broad ligament.

The tubercular poison may reach the sexual organs either from without or through the body from other previously affected organs. Thus the phthisical sputum, or stool, may pass into the vagina from without, and set up mischief, as in cases where, on post-mortem, one finds lung excavation, ulceration of the bowel and vagina, without disturbance of the rest of the sexual tract.

The extension through the body is well known, and happens as follows: Tubercular affection of the intestine is present, and spreads through the wall of the bowel to the peritoneum, and thus affects the tube. It may pass along its lumen and into the uterus, owing to the ciliated epithelium. The bacilli have been detected in the folds of the fimbriated end by Schramm, the rest of the tube remaining sound.

The tubercular affection may further spread by perforation of a tubercular ulcer of the intestine. In one case the ulcer was rectal, opened into the vagina, and in this way the vagina, uterus, and peritoneum were affected, but not the tube. Most authors consider the blood stream as the usual carrier. In one case, of a five month's pregnancy, where the mother died without abortion, from miliary tuberculosis, no tubercle or bacilli were found at the placental site nor in the fœtus.

In infection from without, the contagion may be conveyed by the finger, by irrigation tubes, etc. Coitus and puerperal conditions also afford opportunities.

Genital tuberculosis is more frequent in adults than in childhood, or after the menopause. Fernet gives four cases of women with primary sexual affection, after association with phthisical men; and, on the other hand, one case of caseous epididymitis in a man with no phthisical heredity, after suspicious intercourse. A case of cystitis (tubercular) after coitus, is also recorded where bacilli were found.

While no case of primary tuberculosis during pregnancy is known, it has often been noted after full time or premature births. This affection may be then acute, death occurring in nineteen to thirty-three days, but is also chronic.

We pass over the account of infection by vaccination, circumcision, instruments of gynecologists, as well as Hegar's comparison to gonorrhœal poison, merely remarking that the bacillary nature of tuberculosis explains such instances, that one can also understand mixed infection (gonorrhœa and tuberculosis) and that the tubercular poison may pass either along the mucous genital tract or by the lymph spaces of the connective tissue.

Diagnosis. The points to be considered in diagnosis are, heredity, the occurrence of infantile affections, and opportunities for infection.

The clinical picture will vary according to the site and extent of the process. We may have colpitis, endometritis, and especially chronic pelvic peritonitis; and, when chronic, we may have secondary nervous symptoms, with painful menstruation, sometimes profuse, sometimes scanty. Increase in temperature may be slight.

Early appearance of marked peritoneal exudation is noteworthy, and lung or bowel tuberculosis occurring with pelvic exudations will awaken the suspicion that the pelvic condition is also tubercular. The *physical* conditions are the most important. In vaginal tuberculosis we have miliary nodules, caseous masses, and ulcers. Detection of the bacilli is necessary to diagnosis. The tuberculous uterus is large, partly from tubercular infiltration, and partly from hyperplasia of its normal elements. Nodular enlargement may be found in the tubes, but the uterine enlargement is usually uniform. The affections of the tubes may be such that they are sausage-like or beaded, the enlargements varying in size from a bean to a walnut. These may blend and give a rounded tumor. The position of the tubes is altered—*i. e.*, they may lie at the side of the uterus, on the posterior or lateral pelvic walls, or in Douglas's pouch. They are seldom in the vesico-uterine pouch. Adhesions may occur altering the above conditions, and binding the tubes to the posterior aspect of the broad ligament.

The appearances given are like tubal dropsies, but on section of the tube in pyosalpinx we do not get circumscribed swellings. In tubercular tubes Hegar could squeeze out caseous, wormy masses, evidently from the tube lymphatics.

The tubercular nodules are, in addition, angular and polygonal, and may vary in consistence. The rest of the pelvic peritoneum (broad ligaments, utero-sacral ligaments) may be thickened and infiltrated, and, of course, we may also have general miliary peritonitis. A second form of tube affection is found where ovaries, tubes, and broad ligaments, and even uterus are matted in one large mass. This condition is difficult to separate from malignant or inflammatory conditions of the pelvic organs, and diagnosis in such instances is not easy.

Treatment. The importance of prophylaxis is evident. The marriage of the phthisical must be forbidden or limited. Phthisical and general patients should not be classed together, and in regard to instruments we must look on tubercular infection as we do on that of wounds. Phthisical sputum and stools must be disinfected, and phthisical nurses should not be allowed to attend puerperæ.

The initial stages of colpitis and endometritis have not been observed as yet, but if detected might be cured by curetting and the use of iodoform.

Extirpation of the uterus *per vaginam*, supravaginal excision of the cervix, removal of the tubes and ovaries, or, finally, mere abdominal section with drainage, are all operative possibilities. We must remember that tuberculosis is slower than carcinoma uteri, and that operative interference, even if incomplete, may bring about a cure. Removal of the tubes, ovaries, or uterus is indicated when their tubercular affection is primary, and not tending to quiescence. When secondarily affected, they may still be operatively treated if the changes in the other organs are not causing injury, or are yielding to treatment. Fresh tubercular peritonitis is no hindrance to operation.

The contra-indications to operative treatment are advancing disease in other organs, in which the genital disease plays only a secondary part; a greatly run-down condition, and great fixation of the affected organs, which not rarely indicates breaking down. One can, however, in such cases, open the abscesses and cavities.

Vaginal extirpation of the uterus can only be exceptionally practised, but when tubercular affection of the mucosa has not passed too deeply into the wall, we can employ curetting, cauterization, and application of iodoform. When the tubes are also affected, their vaginal extirpation is difficult, owing to uncertainty in the arrest of hemorrhage. Supravaginal amputation of the cervix needs no special remark, and we, therefore, pass on to the question of salpingotomy with castration.

Salpingotomy and castration can be practised when the tubes, ovaries, and neighboring portions of the broad ligaments are involved; when the uterus is simultaneously involved, but gives hopes of yielding to a later intrauterine treatment, or when peritonitis indicating abdominal section is present.

Hegar specially alludes here to the difficulties encountered when dense adhesions are present, and warns against mistaking the surface of the broad ligament affected, penetrating it, and causing bleeding in attempts to enucleate.

The posterior lamina of the broad ligament is the one on which the tubercular tubes and ovaries usually lie.

In one case he treated a fixed uterine adhesion (three centimetres in diameter) by the extraperitoneal method: and, as the other tube had been deep and fixed, and breaking down caseous matter present, with parenchymatous bleeding going on, he penetrated the vaginal roof, and plugged with a long strip of iodoform gauze, bringing the end into the vagina The result was good.

In one case a small tubercular nodule was on the uterine horn and required intraperitoneal ligature. If the uterine cavity is opened, however, one must treat it extraperitoneal. When the broad ligaments are unyielding, the elastic ligature may be necessary.

The opening and evacuation of tubal tumors through the vagina or abdominal walls, with subsequent drainage, injections, etc., may be employed, when the

patient's strength and the condition of the other organs permit. The relations here are much as in pyosalpinx. The tube walls are often intact and the cavities closed by adhesions of the fimbriated end. The ostium abdominale may, however, be patent, and the wall of the tube perforated. Thus the contents may escape and set up a septic peritonitis. The tube may, in great part, be destroyed and then the cavity made up of false membranes and the pelvic walls or organs. The tumor may be in the true pelvis or projecting up to the abdominal wall, or separated by omentum and intestine. Seldom is it adherent to the parietal peritoneum.

The operations on such tubercular cavities have been performed by Aran, who punctured per rectum. Hegar has performed salpingectomy and castration in six cases. Mandach has performed it once with a good result.

Hegar's results have been as follows: One patient died; a second was well six months after the operation. A third was well six months after, and was free from pain; had not menstruated. Then the period returned as well as the pain, and suspicious lung symptoms came on. The ultimate result three years after the operation has been good. A fourth case had double pleurisy, apex pneumonia, and other troubles four months after operation, but is now, a year after, in good condition. The fifth and sixth cases gave good results.

The following are some of the cases:

Case I. History of suspicious (tubercular) illnesses in childhood; defective development of the uterus (infantile). Amenorrhœa with menstrual molimina; remains of old pelvic peritonitis; tubes with caseous contents. Castration and salpingectomy. Cure. Tubes and ovaries were found adherent and the former were follicular. The tubes were dilated and caseous, the fimbriated end closed. The diagnosis was based on the pelvic condition, the history, and the lung condition.

Case IV. Phthisis in the family; dysmenorrhœa; attacks of pain, especially during the menses. Primary tuberculosis of the tubes; castration and salpingectomy; discovery of the bacilli.

Case V. Beginning of the disease in childbed with endometritis; swelling of lymphatic glands; menorrhagia. Castration and salpingotomy; recovery. Six months after, pleurisy and lymphatic swellings. Condition good one year after.

Tubal Disease.

A. Martin, of Berlin, points out (*Zeitschrift für Geburtshülfe und Gynäk.*, Bd. xiii. Hft. 2) that the chapter on tubal disease is usually one of the shortest in text-books, and one leaving little impression on the reader. These diseases have, however, received attention from several during the last ten years. Hegar, in his classical work on castration, as well as through his pupils, has given his operative experiences. Lawson Tait has vindicated a special *rôle* in the sexual life for the tubes; while Martin and his assistant, Bertram, have published diagnostic and pathological points. Veit has written specially on tubal pregnancy; and Hegar has recently published a special monograph on tuberculosis in the tubes. The special works of Hennig and Bandl must also be taken into account.

Winckel, in 500 cadavera, found the tubes affected in 300. Martin, in 1000

unpicked patients in his Policlinik, found 63 suffering from it, apart from many cases where it was secondary.

Passing over statistics as to age, existence of other pelvic conditions, we note that in 147 cases, chronic or acute, endometric disease was the source of the tubal mischief. 70 times it was in relation to the puerperium, especially that of premature labor.

55 patients were gonorrhœal, 3 had still fresh traces of syphilis, and 10 were tubercular. In 122 cases there were changes in the pelvic peritoneum, ovaries, and broad ligaments, and in 11 the passage of the mischief from tube to peritoneum was traced; in no case was it noted as advancing from peritoneum to tube. In 2 (of the 11) the tube burst; in the others the mischief happened from the passage of fluids into the peritoneum through the ostium abdominale of the tube.

In 91 cases both tubes were affected, in 58 the right only, and in 138 the left only. In regard to the structure of the tube, Martin briefly mentions its mucous membrane, arranged in folds running in the long axis of the tube, and the absence of glands and papillæ. The folding of the mucous membrane is most marked at the abdominal end of the tube. The musculature is most marked at the uterine ends.

The inflammatory processes may be I. *Endo-salpingitis, or catarrhal salpingitis*, II. *Interstitial salpingitis*, and III. *Follicular salpingitis*.

In *endosalpingitis* there is swelling of the folds of the mucous membrane, abundant small-celled infiltration of the mucous membrane, the epithelium remaining intact. The vessels are distended, and ecchymoses are seen here and there.

In *interstitial salpingitis* we have an analogous change in the muscular wall: the tube is of a size varying from that of a lead pencil to that of the little finger. The mucous membrane points at the ostium abdominale.

In *follicular salpingitis* the wall is thickened and enlarged by the presence of what are like cysts on section; the wall seems alveolar and small-celled infiltration with loss of the mucous membrane epithelium is present. Further developments depend on the changes in the muscular walls, in the lumen of the tube, or on the advent of microörganisms. We may thus get distention, muscular hypertrophy, atresia, occlusions of the abdominal end, hydrops tubæ, and so on.

The microörganisms which may infect are those of puerperal sepsis, gonococci, tubercle bacilli, and, in one case, of actinomycosis. The first, Martin believes to be the most common.

In the symptomatology of tubal disease, Martin emphasizes the localization by the patients of the pain in the side of the pelvis, as well as the colicky pains which occasionally end with the escape of fluid from the uterus. Most of the patients complain of profuse pain and irregular menstruation, and have marked disturbance of the general health.

The diagnosis is also made out by palpation, in the way well-known to those who practise bimanual examination.

In treatment, Martin points out the value of medicine, especially antiphlogistic remedies, as only one-fifth of his cases required extirpation. Bleeding, rest, energetic action on the bowels, and narcotics during the paroxysms of pain, as well as remedies causing absorption, should be employed. In gonor-

rhœal cases Martin has used, with good results, unguentum hydrargyri cinerium.

In 72 cases he removed the tubes and ovaries; in 30, both tubes; in 42, one; and in 4 cases he removed first the one and then the other. In most of the cases, adhesions to the ovary and surrounding parts were present, and in some adhesions to the bowel, or even perforation was present. These Martin regards as bad cases, and 3 of his 12 deaths were ascribed to this. In 1, tubercular lung mischief was present, but without tuberculosis in the pyosalpinx. 1 died from cancerous cachexia from primary tubal cancer, 5 died from sepsis, and in 2 the cause of death was unknown.

Martin does not wash out the peritoneum unless he cannot help it, and taps the distended tubes before separating them.

He usually closes the wound fully, or drains either through the vagina or in such a way as to close off the portion requiring drainage from the rest of the peritoneal cavity.

The Diagnosis of Commencing Cancer of the Portio.

Stratz (*Zeitschrift für Geb. und Gynäk.*, Bd. xiii. Heft 1) points out that the operative methods of the treatment of malignant disease of the uterus have so far been tested by time, and we can now say with certainty that carcinoma is curable. Already have cases been recorded where women have enjoyed eight years of undisturbed health after operation.

There is further quite a series of cases of special interest where, on *post-mortem* examination some years after operation, no traces of uterine cancer were found, while often in the ovary, pelvic connective tissue, etc., carcinomatous disease had established itself. One special case where Schröder had performed supravaginal amputation, had, on subsequent section, the scar and uterine remains free, but the whole pelvis filled with malignant masses.

Stratz believes, therefore, that cancer is curable, and that the earlier the operation the better the result. He deprecates palliative treatment as only rendering radical treatment impossible, and condemns those who hold cancer incurable. It is of the utmost importance, therefore, to diagnosticate carcinoma early, and subject it to prompt radical treatment.

He points out, however, that the early symptoms of cancer are so slight that women consult a specialist too late. The family physician has the opportunity of being consulted early, and has the opportunity, therefore, of seeing the initial symptoms, such as increase in the menstrual flow, slight pains, and so on. A specially frequent and well-known symptom is bleeding after coitus. When for such symptoms one can exclude external influences, the question of cancer as their source must be considered.

The early physical signs of carcinoma are not well marked, and it may be impossible to diagnosticate early malignant disease without microscopic examination of the suspicious tissue. Ruge and Veit have shown that one can only suspect beginning cancer from symptoms: this suspicion can be established by microscopic investigation.

Stratz records some cases of early carcinoma, points out the difficulty of diagnosis by the naked eye, and concludes that the important signs of early malignant disease of the cervix are: 1. The affected portion separates sharply

from the sound tissue. 2. One can see a difference in the plane of the affected as compared with the sound tissue. 3. The cancerous portions have a yellowish tinge. 4. The malignant parts are usually small, nodular, whitish-yellow prominences.

On One-sided Hypertrophy of the Vaginal Portion of the Cervix.

The hypertrophies of the supravaginal and middle portions of the cervix are believed to be brought about by traction exerted on these by prolapse in the vaginal wall. On the other hand, the hypertrophy of the vaginal portion is not evident, and has been attributed to the irritation of pessaries, to masturbation, or circulatory disturbances.

One certain fact is that we get hypertrophy of the vaginal portion as the only form in nulliparæ, while in parous women, and in the chronic metritis of nulliparæ, the portio vaginalis is small; in the parous it is large. The hypertrophic processes are either simple or follicular; in the former all the elements of the cervix are involved, in the latter, chiefly the mucous membrane. Partial hypertrophies are associated with cervical laceration. Of such hypertrophies, that of the anterior lip is the most common, the posterior lip following next, and the lateral hypertrophies last. Simple partial hypertrophies are, therefore, associated with lacerations brought about by labor. Follicular hypertrophy may exist in nulliparæ, and is related, doubtless, to ectropion, is always partial, and is not so evidently associated with a preceding labor. Symmetrical follicular hypertrophy has not yet been observed.

Stratz (*Ueber einseitige Hypertrophie des untern Cervicalabschnitts*) takes up more especially one-sided hypertrophies. The only cases of any size are recorded by Cazeau, Tarnier, and Huguier. Three cases are given by Stratz.

Menstruation in Monkeys.

Mr. Bland Sutton (*Brit. Gynec. Journal*, November, 1886) first considers menstruation in the human female. From an examination of the uteri of young females during gestation he has come to the conclusion that during menstruation only the epithelium of the uterus passes away; this is accompanied with blood and mucus. He criticises Dr. Williams's view on the question; but it is important to note, however, that Mr. Sutton does not define the mucous membrane of the uterus as Dr. Williams does, and that he makes no reference to the elaborate papers of Kundrat and Engelmann and Leopold. Dr. Williams includes the muscular fibre of the uterus in the term mucous membrane, and believes that the mucous membrane down to it—*i. e.*, the glandular mucous membrane—is removed. This is a superficial removal only when we consider his definition. The view advanced by Sutton differs little from that given by Leopold.

In Macaque monkeys and baboons during menstruation Sutton has been able to show that the epithelial lining of the uterus is not shed, and that the amount of blood escaping is small.

MEDICAL JURISPRUDENCE AND TOXICOLOGY.

UNDER THE CHARGE OF

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Prophylaxis of Hydrophobia.

Pasteur has recently (November, 1886) communicated to the *Académie des Sciences* the results of the employment of his much heard of method during the one year which has elapsed since he gave his first communication to the Académie on October 26, 1885. 2490 persons, supposed to have been bitten by mad dogs, were treated by his method during that period. The treatment of each was uniform, lasting always for ten days, during which a daily injection of infusion of spinal cord of a rabbit was made, beginning with a cord of fourteen days' exposure, and ending with one of five days. He classifies the patients according to their nationality. It is interesting to note that while, as was to be expected, the majority (about two-thirds) were French, 80 were English, 21 American, and many came from the remotest parts of Europe. Out of the 1726 French and Algerian cases, 10 were unsuccessful, the patients afterward dying of hydrophobia. This is equal to a mortality of 1 in 172. During the five years preceding November, 1885, the number of deaths from hydrophobia in the hospitals of Paris was, on an average, 12 a year. During the year ending November, 1886, there have been only 3 deaths, and in 2 of these the patient had not previously been treated by Pasteur's method. Pasteur believes that these results are strongly confirmatory of the utility of his method.

He has found it necessary to modify his method in the case of patients bitten on the face or head, or bitten very severely elsewhere, especially if the parts were naked. This he does by passing more rapidly than usual, and with omissions, through the injection of the graded cords, until a spinal cord of one day old is used.

Finally, in order to meet the objection which has been raised to the experiments on dogs, on which his method is based, that the dogs were inoculated *before* being bitten, whereas men are inoculated *after* they are bitten, Pasteur has made some fresh experiments on dogs in which he practised intracranial injection with fresh unmitigated virus, and then inoculated the animals some time afterward in the usual way. These experiments were evidently not very successful, hydrophobia appearing in most of them. Pasteur concludes with the remark that the immunity conferred by inoculation previous to infection offers the best proof of the excellence of the method.

Pharmacological and Toxicological Study of Digitalin.

Lafon (*Annal. d'hygiène Publique*, sér. 3, tom. xvi. pp. 429–444, and 506–519) begins with a comparison of the physical and chemical characters of the different commercial varieties of digitalin. These are chiefly the crystallized digitalin of Nativelle, the amorphous digitalin of Homolle and Duquesnel,

and the crystallized and amorphous digitalins of Germany (Merck). The German varieties are fairly soluble in water, while the others are very slightly soluble. In chloroform the latter are more soluble than the former, which are insoluble. Further, the latter do not yield the author's reaction (*vide* this journal, 1886, p. 345) with sulphuric acid and perchloride of iron, while the former do. Further comparison leads to the conclusion that all the French varieties of crystallized digitalin are identical in their physical and chemical properties; that the amorphous digitalin of Homolle and Quèvenne is nearly identical with the digitoxin of the Germans, and resembles the French digitalins in its chemical properties, though considerably differing from them in its fusion point; and that the German digitalin differs from the French digitalin in many of its chemical properties.

In the next place, the author proceeds to prescribe a method of separating the digitalin in a case of poisoning by it. He says Stas's, Otto's, and Dragendorff's methods readily allow of the separation of the digitalin, but not in a very pure form. And as the purity of the separated digitalin is of great importance in the application of the author's color reaction, he describes a modified process by which the digitalin can be obtained in a purer form than is usual. The material supposed to contain the digitalin is to be thoroughly extracted with hot alcohol, then filtered; and the filtrate evaporated until nearly all the alcohol is driven off. An abundant precipitate forms in the aqueous residue, which is separated by filtration through glass wool. Subacetate of lead is now added to the filtrate, which is again filtered. The filtrate is next treated with sulphuric acid to remove the excess of lead, and is once more filtered. The filtrate is now shaken with chloroform, which removes the digitalin in a very pure form, and which, after the evaporation of the chloroform, can be employed for the author's reaction. By such a proceeding the author has been able to detect 1 mgrm. (0.015 grain) in 200 c. cm. of urine, and 3 to 4 mgrms. in vomits, soups, blood, etc.

The next portion of the author's communication is devoted to experiments on the action of digitalin on dogs, given *per os*, subcutaneously, and intravenously. Homolle and Quèvenne's digitalin appears to have been used in all these experiments (which are twenty-five in number) except in one or two, in which digitalis powder was employed. The experiments were mainly directed toward ascertaining to what extent the digitalin could be afterward detected in the body. His conclusions in this respect are (1) where small poisonous doses have been given *per os*, no trace of digitalin is discoverable in the urine, blood, liver, kidneys, lungs, brain, etc. But if the dose is over 10 centigrammes (1½ grains), and vomiting has not occurred, the poison can be detected within the body: (2) the digitalin is most easily found in the contents of the stomach or intestines (or in the vomit); (3) after poisoning *per os* by small doses, digitalin cannot be detected in the internal organs of an animal which has been buried for some time (six to seven months) (4) after poisoning by subcutaneous injection, the digitalin is not to be found anywhere unless in the muscles in the vicinity of the seat of injection; (5) after poisoning by intravenous injection, the digitalin cannot be detected unless the animal dies, or is killed, within ten to twenty minutes after the injection.

With regard to the relative toxicity of the various kinds of digitalin when administered subcutaneously, the author finds that (1) the various crystalline

digitalins (Nativelle's, Duquesnel's, Homolle and Quèvenne's, Mialhe's) have nearly the same activity—about two milligrammes per kilogramme of body weight being sufficient to kill a dog; (2) the so-called "digitalin chloroformique" (Codex) of Homolle and Quèvenne possesses the same toxicity as the foregoing; (3) that the German digitoxin, although considered more active than these others, is not so, and possesses about the same activity.

As to the elimination of digitalin from the organism, the results of the author's experiments appear to point to its more or less complete destruction within the body. It is only found in the urine when very large doses have been administered, even though injected intravenously. In the case of two patients who were receiving 40 centigrammes (6 grains) daily of digitalis leaves in the form of an infusion, no digitalin could be detected in the urine. But if 40 centigrammes of digitalis were digested with urine, the digitalin could afterward be readily separated and recognized.

With reference to the supposed accumulation of digitalin within the body after repeated doses of it, the author was not able to find any confirmation of this supposition.

The author finally investigated the resistance of digitalin to the action of diastase, pepsine, pancreatic juice, bile, mineral acids, caustic alkalies, yeast ferment, and emulsine, as also to the action of putrefaction, and found that the digitalin was little affected. He therefore infers that it is not decomposed in the alimentary canal, but is probably much transformed in the blood.

Accidental Poisoning from the Use of Subnitrate of Bismuth in Surgical Dressings.

Dalché, of the Hotel Dieu, reports two such cases in the *Annales d'hygiène Publique* (sér. 3, tom. xvi. pp. 358–361). The first is that of a woman who was admitted to the hospital with a very extensive burn over the back and left arm. It was dressed with subnitrate of bismuth, the dressing being renewed every two days. About a fortnight after the commencement of the treatment the patient began to complain of slight pain in the throat, accompanied by dysphagia. On the under surface of the soft palate a white false membrane was observed, which extended to the tonsils. In two days the membrane became more extended, and was covered with a blackish mucus. A small patch of membrane was also noticed on the lower lip. The breath became fetid, and the false membranes gradually became detached and loose, but with the formation of new membranes in other parts of the throat and mouth. A few days later diarrhœa, and afterward vomiting, set in. The bismuth dressing was now stopped. The preparation used was found to be absolutely pure, and the presence of bismuth was detected in the feces and the urine. Albumen was also found in the urine. The vomiting and diarrhœa continued for two or three days after the stoppage of the bismuth. But the other symptoms of bismuth poisoning did not entirely disappear until after a month.

The other case was that of a young, thin, anæmic girl, whose knee had been excised and the wound dressed with the subnitrate. A fortnight after the operation, without elevation of temperature, the patient lost her appetite, was salivated, and presented all the symptoms of stomatitis. Bismuth was found in the urine. The course of this case was similar to that of the first.

The author quotes Rabuteau as saying that Dubinsky found "that bismuth, which is largely eliminated in the saliva, produces in the buccal mucous membranes effects which are similar to those of mercury." The author appears to be unaware of Steinfeld's recent investigation of the action of the salts of bismuth.

The New Mortuary in Berlin.

Prof. Liman (*Viertelj. f. gerichtl. Med.*, N. F., Bd. xlv. S. 170–178) gives a description, with plans, of the new mortuary which has just been completed in Berlin. It is a large horseshoe-shaped building, fifty-six metres long, and nineteen metres broad. It has been constructed with three objects in view: (1) To supply an ordinary police mortuary, for the laying out and identification of such dead bodies as come into the possession of the police; (2) to provide accommodation for the complete medical examination of the bodies in needful cases; and (3) for the teaching of medical jurisprudence. The central part of the building is devoted almost entirely to meeting the first of these objects. Besides cellars for holding identified bodies, there are seven small chambers for the exhibition of unidentified bodies, two in each. These chambers are lighted from above, and lie along a public corridor, from which they are separated, as well as from each other, by a glass partition. The temperature in these chambers and in the cellars is kept at 0° to 2° C. by means of copper pipes in which a solution of calcic chloride circulates, the solution being cooled by an ammonia ice machine in an adjacent cellar. On the same level as these chambers are two large rooms, one for washing the bodies and another for depositing the bodies after they are coffined. Conveniently near is a small chapel, where funeral obsequies may be performed in connection with bodies about to be removed for burial. A hydraulic elevator, capable of lifting three hundred kilos., is used for lifting bodies from one story of the building to another. The right wing of the building consists of two stories, one of which is devoted to the medico-legal examination of bodies, and the other to arrangements for teaching. In the former there is a commodious autopsy room, with two tables, two chemical laboratories, two private rooms for the physicians, a room for the crown officer, and a small waiting-room for the witnesses required to identify the bodies; in the latter, which is placed above the other, there is another autopsy room for purely teaching purposes, a lecture-room, a museum, a small library, and private rooms for the director of the institute and his assistant. The left wing of the building is mainly devoted to providing accommodation for servants. It also contains a telegraph office. The building, altogether, appears to be well planned, and might form a model for similar institutions in other towns.

Hanging in Hot Countries.

Pellereau, of Mauritius, gives an interesting account of hanging in tropical climates (*Annal. d'hyg. Publ.*, sér. 3, tom. xvi. pp. 108–125, 1886). Accidental or homicidal hanging is rare, just as in colder countries. Hanging is nearly always suicidal, and is the mode of death most frequently resorted to by suicides. In Port Louis (population, 60,000) fifty cases of suicidal hanging occurred in six years (1878–1883). This mode of suicide is in favor, especially among the

inferior classes of the population, the Creoles and Indians. The better classes, and the Chinese in Mauritius, have recourse more frequently to fire-arms or poison. Hanging is more common among the men than the women. The author has frequently been present at cases of judicial hanging, and has carefully observed the appearances at death and at the autopsy. The phenomena he divides into three successive groups or stages: first, a short period of immobility; second, a period of tetanic rigidity; and third, a period of clonic convulsions. Altogether they do not extend over more than two or three to five minutes. The onset of cadaveric rigidity is somewhat retarded. The post-mortem appearances are, in general, similar to those seen in other countries. In answering the question whether the hanging, in a doubtful case, has taken place during life, the author lays stress on swelling and lividity of the face; tongue between the teeth, enlarged and excoriated; excoriations on the superior and inferior extremities; evacuation of semen; staining of the scrotum and buttocks with urine and feces; mark of the cord; congestion of the brain and its envelopes; congestion of the larynx, trachea, bronchi, and lungs; congestion of the jejunum, ileum, and kidneys; dislocation of the atlas. These appearances may be all present in one case. Sometimes they are nearly all absent. In such a case the trickling out of the saliva from the mouth, and the presence of fragments of food in the larynx, trachea, bronchi, and œsophagus, as also the existence of petechiæ on the inferior extremities, and collapse of the lungs, may be looked for.

PUBLIC HEALTH.

UNDER THE CHARGE OF

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Recent Prevalence of Cholera in Europe.

Dr. Buchanan, F.R.S. the Medical Officer of the Local Government Board of England, has presented to his Board a report, giving (1) account of the prevalence of cholera in Europe in 1884 and 1885; (2) account of the International Conference which was held at Rome; (3) abstract reports on the condition of English ports and other districts in relation to their security against cholera; (4) some recent researches into the pathology of cholera. The first subject only can be referred to in this number.

An important part of the report on cholera prevalence is a statement by Dr. Thorne of the behavior of this disease in different European countries. Much care has been taken to make this as complete as possible, but at the time of its preparation the French Government had not issued their official report, except so far as relates to Paris.

(1884) In France the disease first appeared at Toulon, when, on June 23, 1884, it was announced that fourteen deaths had taken place. The disease was

soon recognized to be epidemic cholera, but some doubt still remains as to the means by which it was introduced. In the first instance it was supposed to have been conveyed by the "Sarthe," a French transport which had recently returned from Cochin China, two cases of the disease having occurred on April 1 and 2, 1884, while the vessel was at Saigon; but it was ascertained that the patients were set ashore, the vessel disinfected, and no other cases occurred during the subsequent forty-five days that the vessel took to reach Toulon. Search was therefore made for other means of introduction of the disease, when it was found that other transports returning from China had also had cases of cholera on board. A considerable exodus from Toulon took place, the disease rapidly extended to Marseilles, and speedily increased in these two cities, the public press returning somewhat over 880 fatal attacks in Toulon, and not very far from 2000 in Marseilles. Monsieur Guérard, an engineer, says that the most neglected portions of the town of Marseilles in point of cleanliness were those which were most fatally affected.

As cholera diminished in the south of France, it manifested itself in the north, beginning at Yport, a small fishing village on the coast of Normandy, where the disease was imported by the arrival, on September 28, of two of the crew of the "Louise Marie" from the port of Cette. An interesting account by Dr. Guibert, of Havre, supplies material which enables the diffusion of the disease in this town to be understood.

By November 1 the town of Nantes had been invaded, and a few days later deaths from cholera occurred in Paris, altogether 938 persons dying in the latter city. The total number of deaths known to have occurred during 1884 in France amounts to some 5000.

In Italy considerable precautions were taken by the government to prevent the introduction of disease into that country; they were of the usual quarantine kind, and are described by Dr. Thorne at some length. Among these precautions was the removal from Toulon of Italian operatives in a vessel especially sent for the purpose, these people being detained in quarantine before being allowed to land at any Italian port. Nevertheless, one Italian workman returning from that city, and after having undergone the required quarantine, developed cholera at Spezia, and other deaths occurred among the soldiers forming the sanitary cordon round the village of Pancalieri at the foot of Monte Viso, where some Italian workmen from Toulon had been taken ill. In the meantime cholera had appeared in Cuneo on June 28th, Livorno on July 14th, Porto Maurizio on July 17th, Genoa on July 19th, and Turin on July 20th. The disease rapidly spread, and reached Naples by August 27th.

With a view to confining the disease in Spezia, there were provided a military cordon on shore, and a maritime cordon in the bay, supported by gunboats, but it was largely evaded, and it is stated that within two days of the official announcement of the epidemic in Spezia, no less than six thousand of the inhabitants fled from the place. In September there was a great increase in the severity of the epidemic and in its diffusion, numerous deaths occurring in the province and city of Genoa, in the provinces of Parma, Bergamo, Cuneo, Massa, Carrara, and Caserta.

In the city of Genoa cholera was attributed, according to local correspondents, to the use of polluted water supplied by the aqueduct of the Nicolai

Society, the source of which is near Busalla, where cholera had been very prevalent, and in this water it is stated the clothes of cholera patients had been washed. The municipality ordered the Nicolai Society to discontinue the supply of this water.

Rome remained free, but the disease extended to the Adriatic provinces of Rovigo and Ferrara, and outbreaks occurred in some of the more scattered portions of the peninsula, a single death also occurring in Palermo.

In Naples the disease manifested itself with the greatest severity, by the end of September 5700 cholera deaths having taken place in the city, in addition to 520 deaths in other parts of the province. The disease is believed to have been introduced into Naples by Sicilian workmen from Marseilles who, after having been subjected to quarantine, arrived in Naples on August 3d, and took up their quarters in the Porto district, of which the sanitary circumstances were most defective. They were subsequently removed to a floating lazaretto, but it is believed the removal came too late, for two days afterward the first case of cholera occurred in the city. The four districts of the city most severely affected were those notoriously the most unhealthy and filthy.

The epidemic in Italy was maintained up to the middle of October, but terminated at the end of that month. The total fatality of the disease in that country, judged from the various sources to which Dr. Thorne had access, being 11,500 persons; but this number, Dr. Thorne remarks, falls short of the actual mortality from this disease, which, according to a report of the Ministry of the Interior at Rome, caused a total of 27,030 cases, and 14,299 deaths.

In Spain, where quarantine regulations were strictly enforced, cholera also made its appearance, invading first Novelda and Monforte, two inland towns in the Mediterranean province of Alicante, where deaths occurred late in August or early in September. Subsequently Elche, in the same province, was attacked, and on the 18th of September cholera appeared in the coast town of Alicante. There is reason, however, for believing this port to have been invaded at an earlier date, the disease being imported by a vessel from Algiers, which had amongst its passengers a family from Cette, who took up their abode in a house where cases of cholera subsequently appeared.

The disease thus spread in the provinces of Alicante, Tarragona, and Lerida, and at the end of November deaths were recorded in Toledo and in the coast province of Valencia, and finally, in December, four deaths occurred at Vergel, close to the northern boundary of the province of Alicante. In all, intelligence was received of 274 cholera deaths in Spain during 1884.

In England, in 1884, on three occasions ships arrived with cases of cholera on board, or with persons who were convalescent from attacks of cholera; the sufferers were in each instance removed to hospital, and there was no subsequent case of cholera on shore.

(1885) During the following year (1885), in the beginning of June, cholera was publicly announced to be prevailing in Spain, the cases being situated in Castellon, Valencia, and Mercia, and a few cases in Madrid, the three coast provinces neighboring to that of Alicante, which suffered from the disease in 1884. Before this announcement, however, it was known that a dangerous epidemic of some sort prevailed at Xativa, in the province of Valencia, and that there were other cases in the southwest portion of the same province.

Portugal and France, moreover, had declared Spain to be infected, and quarantine measures were imposed. During June the disease spread rapidly in each of the above provinces, attacking a number of cities, including the cities of Cienpozuelos, Cartagena, Saragossa, Aranjuez, Cuença, and Toledo, and the provinces of Huesca, Saragossa, Cuença, Alicante, Toledo, and Teruel.

During July the epidemic increased both in severity and in the area of its diffusion, and in August the infected area included further the provinces of Gerona, Navarre, Logrono, Burgos, and Palencia to the north, Almeria to the extreme south, Salamanca on the west, and Valladolid and Guadalajara toward the centre of the kingdom. The month of September exhibited a considerable decrease in the intensity of the epidemic, but Dr. Thorne observes that the extent and suddenness of the decrease cannot have been anything like as great as would appear from the published statistics.

Altogether 338,685 cases were reported, and 119,620 deaths. Of the large Spanish towns Aranjuez was by far the most severely stricken. Within only one month 19.8 per cent. of the nominal population suffered, and 10.1 per cent. died of cholera.

Gibraltar had altogether 34 cases, and 25 deaths; the disease, according to Surgeon-Major Staples, resembling in its incidence the epidemic of 1865, the poor quarters being mainly attacked, where impurity of air from overcrowding, faulty sanitary circumstances, the impurity of drinking water, and unwholesome food supplies were associated with its prevalence.

It is noteworthy that with a population of some 24,000 persons the cholera deaths in Gibraltar amounted to 23, whereas in the neighboring Spanish town of Linea, with only about half as large a population, no less than 194 fatal attacks occurred.

The necessity of bringing food supplies from Linea into Gibraltar, which is entered daily by some 4000 persons from Spain, rendered it impossible to prevent communication between these two places, and no measures of land quarantine or other restrictions on the movements of the population were attempted.

In 1886 the disease lingered during the first few months at Algeciras, in the province of Malaga and at Tarifa.

In France, in 1885, there was no record of cholera until August 2d, when 12 fatal attacks were reported in Marseilles. From this date the disease rapidly extended, lasting until the middle of September, and causing 1039 deaths. In Toulon a fatal case occurred on August 8th, and subsequent cases were reported even as late as October, making a total of 314 deaths.

During October, 1885, deaths from a disease resembling cholera were reported as having occurred in the department of Finisterre, in November three cholera deaths were reported from the Pyrénées Orientales, and early in the same month the disease also appeared in the neighborhood of Quemper, being apparently introduced into this district from Toulon by the arrival of seamen on furlough from war ships or transports from Tonquin.

In Italy, in 1885, a few cases of cholera occurred at Gaëta in January, and from that time till August 1st no cases are known to have occurred. In this month cases were reported in the following provinces: Naples, Massa, Genoa, Cremona, Porto Maurizio, Venice, Parma, Piacenza, Alessandria, Modena, and Caserta. On September 6th cholera appeared in Palermo, the capital of

Sicily, causing a serious mortality during that month, but diminishing during October. The epidemic occasioned 2287 deaths, while in the rest of the province of Palermo further deaths to the number of 672 occurred, a smaller number of deaths taking place in other parts of the island. During September other Italian provinces were invaded, in the majority the outbreaks being trivial; but in the provinces of Reggio Emilia, Rovigo, and Ferrara they were more serious. The official report issued by the Minister of the Interior gives account of 6397 attacks, and 3459 deaths among the inhabitants of Italy during 1885.

In the latter part of the year the disease subsided, and from the end of October until December 23 no further intelligence was forthcoming; but at that date a few cases occurred in the city of Venice, and others in the rest of the province.

(1886) For the first three months of 1886 there was no information of cholera in Italy, but in the beginning of April cases were reported on the coast at Brindisi and Manopoli, others during the month occurring in the surrounding country. Again, a few cases were reported on May 1 in Venice, and the mortality continued until the close of May, when there had been 276 cases and 151 deaths in this place.

England remained free from cholera during 1885 and 1886, but in a few instances vessels arriving from foreign infected ports, having had on board deaths from cholera or diarrhœa, were dealt with under the cholera order of 1883.

Dr. Buchanan notes that Dr. Thorne "gives some instructive and significant illustrations of the relation between filth and our present cholera epidemic; he further shows that each country which had been invaded received the disease by its littoral provinces, and he tells how countries which profess to take strict quarantine precautions have suffered; some very severely, and others (it would seem) not at all, the latter resembling in this respect our own country, which imposes no quarantine whatever against cholera upon any of the multitude of vessels which reach its shores from the infected countries."

Account will be given of the other subjects in the report in the next number of this journal.

Recent Inoculations of Smallpox Virus.

The *Gazette Médicale de Nantes* relates the history of smallpox from which the inhabitants of Tanganika suffered so long. Whole villages were destroyed by this terrible disease, and though lymph had several times been brought from Europe, it had always failed to produce any result in those vaccinated. At last it was determined to try inoculation with smallpox matter. Five hundred persons were inoculated; of these none died, the majority had three pustules at the site of inoculation, some had two, or even one pustule, but all had fever, a few somewhat severely. The material for inoculation was taken from a smallpox patient, a child who had an attack of discrete variola, and the lymph from its pustules was inoculated into all who came. The same happened in other towns; in only one case did the person die after being inoculated, and he was, probably, incubating smallpox at the time of the operation. In one village, in forty-eight hours, over five hundred

were inoculated, and since that time only four persons in that village have died from variola, none of them being willing to submit to inoculation.—*Journal d'Hygiène*, vol. ii., No. 529.

Inspection of Meat in Paris.

In Paris the police are charged with the duty of regulating the sale of meat, and inspecting all meat sold within the city. The law which is concerned with the suppression of fraud with regard to provisions was passed in 1851, but the decree of the prefect of police of 1879 is that under which the police act for the seizing and condemning of meat. There are 57 inspectors, and before they can be admitted they must pass an examination on some veterinary subject, and also a practical examination at a slaughter-house in Paris. No butcher's meat or pork, fresh, salted, or smoked, may enter Paris without previously being inspected, save in very small quantities. The meat must only enter by certain gates, or during certain hours; all meat found to be unfit for consumption is seized at once and destroyed at the expense of the owner, except when he requires it to be returned to him for industrial purposes, it is then sprinkled with oil of turpentine, or some other chemical, to prevent its being used for food. It is sold to horse-killers when quite unfit for food, but when only contaminated it is handed to the guardians of the Jardin des Plantes for the use of the animals. Other provisions, also, undergo a rigorous inspection under the same law, but by a different class of inspectors, who report to the Municipal Laboratory of Chemistry. There are twenty inspectors, and two are attached to each of the ten sections of the city. They examine provisions in the markets and in the shops, and they are also provided with a microscope and reagents for testing. If the goods are really bad they are destroyed at once; if only adulterated they are analyzed, and the owners punished by fines, or even imprisonment. The inspectors report every day, and record all the work performed in each section of the city.—*British Medical Journal*, January 8, 1887.

The Etiology of "Charbon," and the Drainage of Marsh Land.

Messieurs Bouley and Raynal, in their *Dictionary of Veterinary Medicine*, give their views with regard to charbon.

In countries where marshes occupy a large surface, charbon is most often observed, also in places exposed to inundations, or where there is much stagnant water: and again, this disease produces the greatest ravages where the drinking water is brackish.

Thus, the Sologne, a plateau in the department of the Loiret, Loir et Cher, and Cher, is the chief of the marsh lands of France; it consists of vast ponds and valleys where it is difficult for the water to flow away, and which are easily transformed into marshes during the heat of the summer. Next in order come the departments bordering on the sea, also the marshes of the Dombe, La Bresse, and Breime.

Again, charbon is known, not only in France, but in other countries of Europe which have marsh land. M. Verheyen says it is enzootic in Esthonia, Livonia, and Courland; also in Poland and several districts of Germany. Charbon, he remarks, appears every year, and by preference attacks those

animals which live in fields near the mouth of rivers, or where the ground is swampy.

In Spain charbon is enzootic in valleys which are under water at certain times, and in Siberia where there are innumerable lakes and swamps, the animals are decimated every year by "jaswa," or a charbon fever, which, in one year, killed about 100,000 horses.

The method adopted in many countries to counteract the influence of the marshes is to remove all flocks and herds to high plateaus in the mountains at the beginning of summer. It is well known that the soil of marshes is generally flint-clay, not permeable to the stagnant water, which covers its surface; they are, moreover, always more or less muddy, smelling most unpleasantly, and containing a number of aquatic plants, and much infusorial life; besides this, all marshes exhale carbonic acid and sulphuretted hydrogen.

The miasma produced is dependent upon the temperature, and thus during the months of July, August, and September, the marsh lands are the most unhealthy, and charbon is most likely to appear. When the bottom of the marsh is neither completely submerged nor completely dry, fermentation is easily induced, the conditions most favorable for the development of charbon result, and a septic substance is introduced into animals which either produces charbon, or some allied disease.—*Journal d'Hygiène*, vol. ii., No. 533.

Red Cod.

In a report addressed by Dr. Heckel, of Marseilles, to the Ministre de la Marine (*Journal d'Hygiène*, vol. xi. No. 521, p. 462), he states that the loss to the fisheries and fish merchants by the prohibition of the use of "*red*" cod amounts to at least twenty million francs, and he has, after careful consideration, come to the conclusion that the red cod is not always poisonous, indeed it is so very rarely; it may become red without being poisonous, and he believes that the red color of the cod is due to a species of fungus. A Spanish newspaper, the *Imparcial*, of March, 1886, gives an account of the discovery in 1878, in the United States, of a red fungus in dried cod, which was ascribed by the commercial world to the use of Mediterranean salt for preserving. In 1884, Algiers seems to have suffered from the same disease, and the same year Bérenger Férand stated that in Lorient 200 men out of 380 on board the "Vengeance" had been attacked after eating dried red codfish. The symptoms were the same as after partaking of any decomposed article of food—serious disturbance of the digestive apparatus and more or less disturbance of the nervous system. It is supposed to be due to a poisonous alkaloid, "ptomaine."

Several other accounts have been given of this poison or species of rust which is found in dried codfish, amongst them is a publication by Drs. Layet, Artyales, and Ferré, of Bordeaux. They say that on the surface of dried codfish, affected in this manner, and between the muscles on the surface are organisms of a vegetable character which cause this reddish coloring. They take the form of "sarcinæ." They are found in heaps together with a granular substance, formed from remnants of tissue: they are most numerous near the crystals of salt, and they seem to penetrate with the salt in between the muscles and decompose the tissue.—*Deutsche Vierteljahrsschrift f. öff. Gesundheitspfleg.*, Bd. 18, No. 4, S. 633.

INDEX.

ABDOMEN, laparotomy for gunshot wounds of, 256
Abscess, cold, treatment of, 549
Abscess, perityphlitic, laparotomy for, 259
Acid, cacodylic, 295
Acid, carbonic, inhalation and rectal injection of, 527
Acid, cobric, 296
Acid, salicylic, bullous eruption following administration of, 275
Actinomycosis hominis, 75
Actinomycosis in man, 247
Agencies, vasomotor, plethysmographic research on, 523
Ainhum, 137
Albuminose, poisonous action of, 295
Albuminuria, 34
Albuminuria, cyclic, 532
Albuminuria, paroxysmal, 534
Alcohol in acute febrile diseases, 527
Anæmia, progressive pernicious, treatment of, 220
Antifebrin, 223, 528
Antipyrin, 530
Artery, subclavian, collateral circulation after ligature of the, 215
Artery, the ophthalmic, 519
Asiminine, 218.
Astigmatism, ciliary correction of, 267
Asymmetry, corneal, ciliary correction of, 560
Atkinson, rubella, 17
Atropine, action of, on the heart, 369

BACILLI, cholera, poisonousness of, 538
Bacillus anthracis, influence of light on development of, 216
Bacteriology, 101, 422
Bastian, Paralyses: Cerebral, Bulbar, and Spinal, 204
Bates, intestinal concretions, 440
Berry, Subjective Symptoms in Eye Diseases, 487
Beyer, action of atropine, homatropine, hyoscine, hyoscyamine, and daturine on the heart, 369
Bladder, rupture of the, 554
Bone, temporal, recognition of important topographical features of, 566
Bowditch, action of sulphuric ether on the peripheral nervous system, 444
Bowel, sarcomatous tumor of, 254
Brain, abscess of, following otorrhœa, 270
Breathing, periodic and "luxus," 524
Breker, Pathological, Histological, and Bacteriological Methods of Investigation, 191
Brodeur, Surgical Intervention in Renal Affections, 514
Bryant, Operative Surgery, 498
Buck, Reference Handbook of the Medical Sciences, 208
Buckmaster, twenty-two cottage cases, 467
Butlin, Diseases of the Tongue, 193

CAFFEINE, action of, 221
Calcium, hypochlorite and hyposulphite of, 298
Calculi, tonsillar, 552
Calomel in diseases of the heart, 535
Cancer, Chian turpentine in, 547
Cannabinum tannicum, 222
Carcinoma, excision of clavicle for, 485
Cardiopathies, arterial, curability of, 220
Carpus, morphology of, 211
Cases, twenty-two cottage, 467
Cataract, extraction of, 264, 560
Centres, the primary optic, 520
Cephalalgia pharyngo-tympanica, 541
Cervix, hypertrophy of vaginal portion of, 593
Charbon, etiology of, 603
Cheyne, bacteriology, 101, 422
Chlorosis, treatment of, 533
Cholera, recent prevalence of, in Europe, 598
Choroiditis disseminata, origin of, 563
Circulation, portal, changes in the, 539
Clavicle, excision of, for carcinoma, 485
Cocaine in ophthalmic surgery, 455
Coccyx, excision of, 250
Cochlea, primary disease of the, 568
Cod, red, 604
Cohn, Hygiene of the Eye in Schools, 487
Concretions, intestinal, 440
Consumption, treatment of sweating of, 530
Corpus uteri, septic, amputation of, for puerperal disease, 583
Cortex, cerebral, topography of, 342
Culver, Refraction and Accommodation of Eye, 487

DATURINE, action of, on the heart, 368
Dermatitis, exfoliative, 577
Deutschmann, Suppurative Meningitis following Enucleation, 487
De Wecker, Treatise on Ophthalmology, 487

Diaphragm, movements of the, 214
Digitaline, 594
Disease, Bright's, pathology and treatment of, 234
Disease, chronic Bright's, neuro-retinitis and, 562
Disease, tubal, 590
Diseases, acute febrile, alcohol in, 527
Diseases, heart, calomel in, 535
Diseases, heart, nitroglycerine in, 531
Diseases, industrial, 304
Diseases, puerperal, relation of gonorrhœal infection to, 287
Dressing, subiodide of bismuth as a, 260

EAR, epileptiform symptoms from disease of the, 565
Ear, recently described anatomy of the, 568
Ear, middle, atrophy of the, 413
Electrolysis, removal of hair by, 575
Endocarditis, ulcerative, 55
Enucleation and exenteration, 561
Ergot, 297
Ernst, experimental research upon rabies, 321
Eruption, scarlatiniform, following injuries, 278
Eruptions, medicinal, 275, 574
Erysipelas, intrauterine transmissibility of, 286
Erythema multiforme, 278
Ether, sulphuric, action of, upon peripheral nervous system, 444
Eulyptol, 220
Eye, etiology of constitutional diseases of the, 562
Eye, parasitical diseases of the, 561

FECAL accumulation, operation for, 557
Ferments, urinary, condition of, in Bright's disease, 533
Ferrier, Functions of the Brain, 204
Fever, typhoid, antifebrin in, 535
Fever, typhoid, sublimate treatment in, 540
Fever, typhoid, laryngitis of, 570
Fever, typhomalarial, 395
Finlayson, Clinical Diagnosis, 197
Foot, mechanism of the skeleton of the, 213
Frost, cocaine in ophthalmic surgery, 455
Fuchs, Cause and Prevention of Blindness, 487
Functions, mammary, development of, by the skin of lying-in women, 285

GANT, Science and Practice of Surgery, 203
Gastrotomy, 572
Gestation, extrauterine, electricity in, 582
Gifford, Direction of the Lymph-streams in the Eye, 487
Gland, thyroid, pathology of the, 553
Glioma, retinal, doctrine of, 564
Glucose, new tests for, 237
Glycogen, formation of, 218
Glycosuria, ephemeral, 548
Goitre, intraglandular extirpation of, 552
Gowers, Diseases of the Nervous System, 204

HÆMOGLOBINÆMIA, 233
Hair, removal of, by electrolysis, 575
Hammond, Diseases of the Nervous System, 516
Hanging in hot countries, 597
Hardy, Diseases of the Skin, 195
Hearing, defective, in railroad operatives, 564
Heart, calomel in diseases of the, 535
Heart, electric state of, on vagus stimulation, 522
Heart, sclerosis of valves of, 235
Heat, febrile, effect of fluids on, 529
Hemicrania, antipyrin in, 530
Hemorrhage, gastric, 535
Hemorrhage, middle meningeal, 243
Hernia, oblique inguinal, 253
Hernia, properitoneal, 253
Hinsdale, the station of man, 478
Hip, dislocation of the, 550
Homatropine, action of, on the heart, 369
Horsley, topography of the cerebral cortex, 342
Huber, Pathological, Histological, and Bacteriological Methods of Investigation, 191
Hueppe, Methods of Bacteriological Investigation, 191
Hun, cerebral localization, 140
Hutchinson, Pedigree of Disease, 180
Hydrophobia, prophylaxis of, 594
Hyoscine, action of, on the heart, 369
Hyoscyamine, action of, on the heart, 369
Hypertrichosis, treatment of, 576
Hypnone, 528

ICHTHYOL, 574
Icterus, investigations concerning, 531
Impetigo contagiosa, 580
Infection, milk, 298
Intussusception, 558

KELOID, 277, 576
Kidney, new method of exposing, 556
Knee-kick, 88

LABYRINTH, affections of the, 568
Landolt, Treatise on Ophthalmology, 487
Landolt, Refraction and Accommodation of Eye, 185
Lane, Operative Surgery, 498
Lanolin, 573
Laparotomy, 255, 256, 259, 580
Laryngology and rhinology, journal of, 570
Larynx, ecchondroses and exostoses of the, 571
Larynx, influence of ether upon muscles of the, 572
Larynx, intubation of, 258
Leucæmia, the organ of hearing in, 268
Lichen ruber, 574
Limbs, gangrene of, 551
Literature, recent surgical, 240, 543
Litholapaxy, 555
Lithotomy, suprapubic, 251
Lobeline, 523
Localization, cerebral, 140
Locomotor ataxia, treatment of pains of, 225
Lombard, knee-kick, 88
Lupus, treatment of, 272, 273, 578

MAISCH, National Dispensatory, 513
Malleoli, relative development of, 212
Man, the station of, 478
Meat, inspection of, in Paris, 603
Menstruation in monkeys, 593
Micrococcus, a new, 539
Microörganisms and acute suppuration, 244
Mollin, 274
Monkeys, menstruation in, 593
Mortuary, a new, in Berlin, 597
Morris, How We Treat Wounds To-day, 498
Morris, Surgical Diseases of the Kidney, 169
Movement, voluntary, rhythm of, 522
Movements, respiratory, innervation of, 525
Muscle, smooth, regeneration of, 522
Muscle, the abductor ossis metatarsis quinti, 519
Muscle, the abductor minimi digiti pedis, 519
Muscles, voluntary contraction of, 217
Muscles, extensor proprius digiti and peroneus digiti quinti, 214
Mycosis fungoides, 578
Myoma, amputation of uterus for, 296

NAPHTHALIN in affections of the urinary organs, 224
Neck, tumors of, 248, 551
Nettleship, Case of Meningitis, 487
Neuritis, primary degenerative, 538
Neuro-retinitis and chronic Bright's disease, 562
Nitroglycerine in heart diseases, 531

OBSTRUCTION, intestinal, laparotomy for, 255
Œsophagus, stricture of the, 572
Operation, the Alexander, 289
Operation, the Porro, 282, 285
Ophthalmia, gonorrhœal, in newborn child, 289
Organs, double sexual and urinary, 292
Organs, urinary, naphthalin in affections of, 224
Otitis interna, pathology of, 569

PANCREAS, surgery of the, 121
Pepper, System of Medicine, 174
Pepsin, 523
Pepsinogen, 523
Peptones, poisonous action of, 295
Peritonitis, treatment of, 255, 533, 585
Pilocarpine, 565
Plexus, brachial, minute anatomy of the, 521
Pneumonia, studies in, 225
Poisoning, iodoform, 246
Poisoning, mushroom, 303
Poisoning, sublimate, 585
Poisoning, subnitrate of bismuth, 596
Polypi, fibrous, complicating the puerperium, 585
Polypus, post-nasal, epileptiform seizures from, 571
Portio, diagnosis of commencing cancer of, 592
Potassium iodide, eruption from, 275
Pregnancy, tumors complicated with, 281
Process, mastoid, trephining the, 566
Prudden, ulcerative endocarditis, 55
Psoriasis, etiology of, 276
Pustule, malignant, treatment of, 546

RABIES, experimental research upon, 321
Race-character, neural spines of the cervical vertebræ as a, 211
Rash, iodoform, 277
Refuse, disposal of, 301
Retina, anæsthesia of, 262
Retina, chromatic sensitiveness of the periphery of, 265
Reviews—
Bastian, Paralyses: Cerebral, Bulbar, and Spinal, 204
Berry, Subjective Symptoms in Eye Diseases, 487
Brodeur, Surgical Intervention in Renal Affections, 514
Bryant, Operative Surgery, 498
Buck, Reference Handbook of the Medical Sciences, 208
Butlin, Diseases of the Tongue, 193
Cohn, Hygiene of the Eye in Schools, 487
Culver, Refraction and Accommodation of Eye, 487
Deutschmann, Suppurative Meningitis following Enucleation, 487
De Wecker and Landolt, Complete Treatise on Ophthalmology, 487
Ferrier, Functions of the Brain, 204
Finlayson, Clinical Diagnosis, 197
Fuchs, Causes and Prevention of Blindness, 487
Gant, Science and Practice of Surgery, 203
German Gynecological Society Transactions, 505
Gifford, Direction of the Lymph-streams in the Eye, 487
Gowers, Diseases of the Nervous System, 204
Hammond, Diseases of the Nervous System, 516
Hardy, Diseases of the Skin, 195
Huber and Breker, Pathological, Histological, and Bacteriological Methods of Investigation, 191
Hueppe, Methods of Bacteriological Investigation, 191
Hutchinson, Pedigree of Disease, 180
Index-Catalogue, 207
Landolt, Refraction and Accommodation of Eye, 185
Lane, Operative Surgery, 498
Morris, How We Treat Wounds To-day, 498
Morris, Surgical Diseases of the Kidney, 169
Nettleship, Case of Meningitis, 487
Pepper, System of Medicine, 174
Sajous, Diseases of the Nose and Throat, 201
Schafer, Diseases of Women, 210
Sharkey, Spasm in Chronic Nerve Disease, 511
Smith, Operative Surgery, 498
Stillé and Maisch, National Dispensatory, 513
Treves, Anatomy of Intestinal Canal and Peritoneum in Man, 183
Treves, Manual of Surgery, 209
Von Arlt, Diseases of the Eye, 487

Reviews—
Von Ermengen, Recent Investigations Concerning the Cholera Microbe, 191
Von Zeissl, Pathology and Treatment of Syphilis, 515
Warren, Healing of Arteries after Ligature, 512
Weisse, Practical Human Anatomy, 190
Richey, atrophy of middle ear, 413
Rubella, 17

SAJOUS, Diseases of the Nose and Throat, 201
Scarlatina following injuries, 278
Scars, hypertrophied, treatment of, 277
Schaffer, Diseases of Women, 210
Scleroderma, clinical study of, 577
Section, mesial, of a pregnant woman, 287
Senn, surgery of the pancreas, 121
Sensation, luminous, heat the retinal intermediate of, 267
Sharkey, Spasm in Chronic Nerve Disease, 511
Shepherd, ainhum, 137
Sinus, maxillary, acute suppuration in, 572
Skerritt, actinomycosis hominis, 75
Skin, trophoneurosis of, 274
Sloan, excision of clavicle for carcinoma, 485
Smallpox, inoculation of virus of, 602
Smith, Operative Surgery, 498
Smith, waking-numbness, 410
Snakes, poisonous, nature and action of venom of, 296
Sparteine, sulphate of, 224
Spine, cervical, treatment of caries of, 249
Squint, the amblyopia of, 563
Squire, typhomalarial fever, 395
Station, the, of man, 478
Stewart, albuminuria, 34
Stillé, National Dispensatory, 513
Stomach, cancer and ulcer of, 535
Strabismus, origin of, 266
Stricture, organic, in white and colored races, 259
Suppuration, acute, and microörganisms, 244
Surgery, abdominal, 584
Surgery, antiseptic, 258
Surgery, brain, 244
Surgery, hepatic, 556
Surgery, ophthalmic, cocaine in, 455
System, genito-urinary, epiblastic origin of the, 215
System, peripheral nervous, action of ether upon, 444

TARSUS, morphology of, 211
Tetanus, 249, 545
Therapeutics, cutaneous, pastes in, 578
Tissue, muscular, action of lime, potassium, and other salts on, 297
Tract, motor, character of muscular contractions evolved by excitation of various parts of, 216
Treves, Anatomy of Intestinal Canal and Peritoneum in Man, 183
Treves, Manual of Surgery, 209
Tuberculosis, injection of lactic acid in, 571
Tuberculosis, genital, in women, 586
Tumor, sarcomatous, of bowel, 254
Tumors complicated with pregnancy, 281
Tumors, malignant, arsenic in treatment of, 247
Tunica vaginalis, pathology of hæmatocele of, 251
Turning, cause of difficulty in, 288
Tyrotoxicon, 302

URETHAN, 224
Urine, clinical value of uric acid sediment in the, 540
Urine, diabetic, examination of, 534
Urine, diabetic, formic acid in, 239
Urine, influence of venous stasis on the, 524, 541
Urine, normal, acetone in, 239
Urine, reactions of, after use of naphthalin, 239
Urine, significance and determination of globulin in the, 542
Uterus, amputation of, for myoma, 290
Uterus, forcible tearing out of the, 582
Uterus, the pregnant and parturient, 279

VASELINE, hypodermatic use of, 530
Veins, varicose, treatment of, 549
Virginity, signs of, in an exhumed body, 293
Von Arlt, Diseases of the Eye, 487
Von Ermengen, Recent Investigations Concerning the Cholera Microbe, 191
Von Zeissl, Pathology and Treatment of Syphilis, 515

WAKING-NUMBNESS, 410
Warren, Healing of Arteries after Ligature, 212
Water, effects of, at different temperatures, 291
Weisse, Human Anatomy, 190
Whooping-cough, treatment of, 529, 571

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